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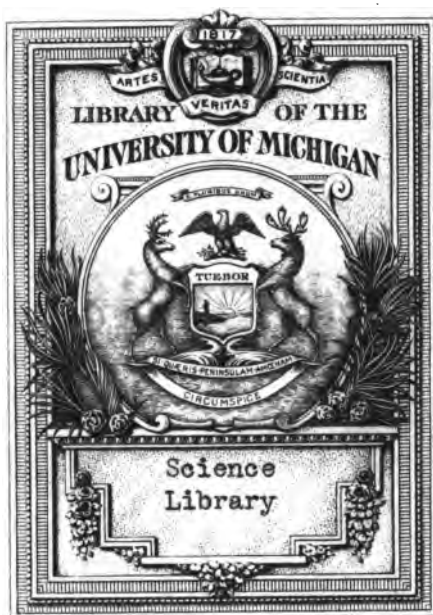
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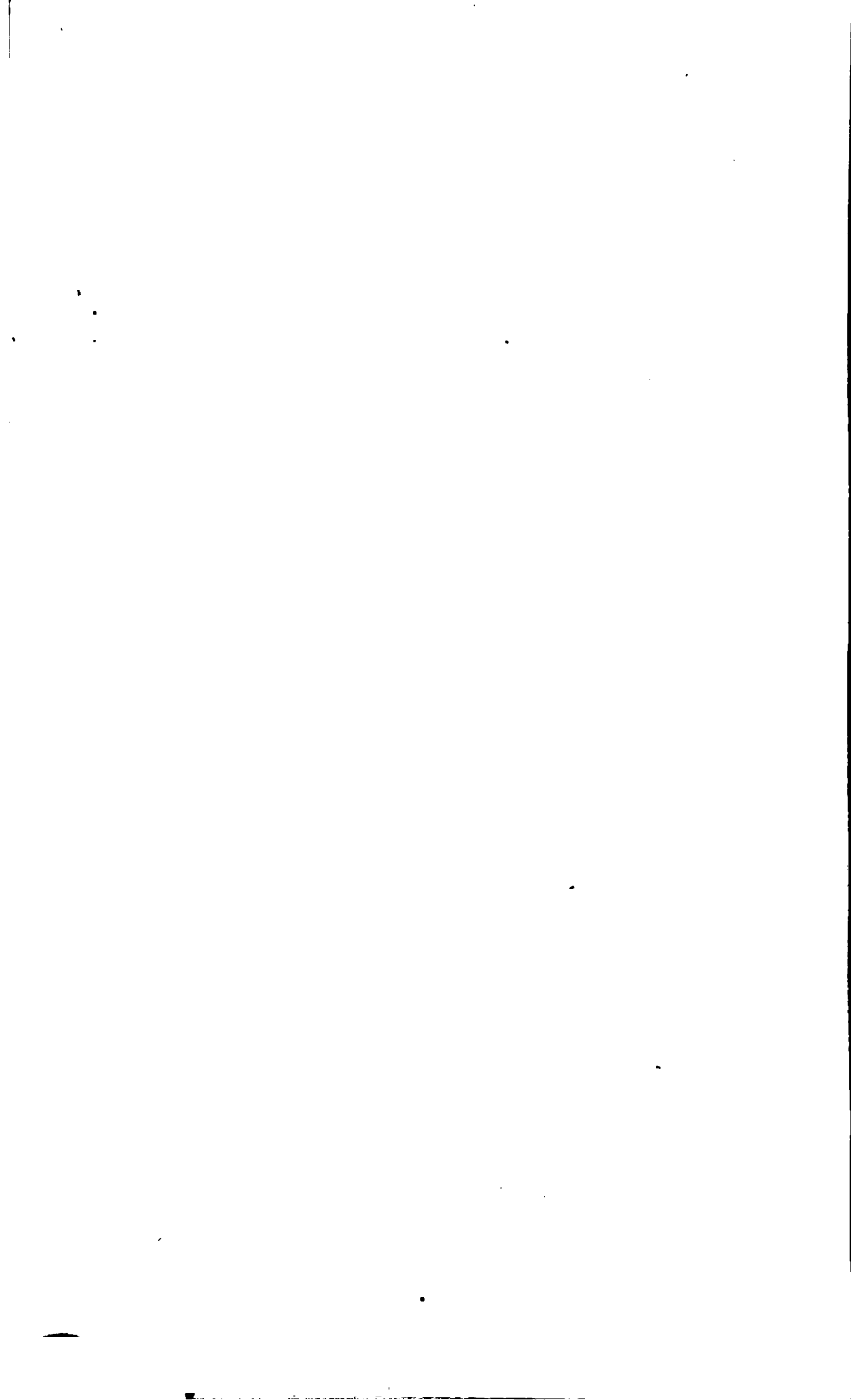
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CACTACEÆ OF NORTHEASTERN AND CENTRAL MEXICO

TOGETHER WITH A SYNOPSIS OF
THE PRINCIPAL MEXICAN GENERA

BY

WILLIAM EDWIN SAFFORD

FROM THE SMITHSONIAN REPORT FOR 1908, PAGES 525-563
(WITH PLATES 1-15)



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CACTACEÆ OF NORTHEASTERN AND CENTRAL MEX-
ICO, TOGETHER WITH A SYNOPSIS OF THE PRIN-
CIPAL MEXICAN GENERA.

[With 15 plates.]

By WILLIAM EDWIN SAFFORD.

Scarcely any group of plants in the whole vegetable kingdom is more remarkable for its strange and varied forms, the beauty of its flowers, and its wonderful adaptation to desert life, than the cactus family. To many persons the word "cactus" suggests perhaps the beautiful night-blooming cereus of our conservatories or the rosy-flowered Epiphyllums and Phyllocacti. These plants, together with the drooping epiphytal Rhipsalis, call up visions of tropical luxuriance far different from those suggested by the stiff columnar torch thistles and thorny viznagas of the arid deserts and rocky slopes of mountains. Many of the latter are figured in various government reports of explorations, in which some of the most remarkable are described at length, not only as striking features of the landscape, but also as welcome sources of refreshment to the weary traveler, and food and drink for his exhausted beasts of burden.^a

Humboldt has somewhere spoken of the influence of collections of exotic plants upon minds susceptible to natural beauty, relating how he himself was seized with a desire to travel in tropical countries on seeing certain exotic trees in the botanical garden of Berlin. Among special collections of plants usually seen in conservatories few inspire greater interest than those composed of Cactaceæ. In this country the most important collection is undoubtedly that of the Missouri Botanical Garden, at St. Louis. Other interesting collections are those of the Department of Agriculture, at Washington, and the New York Botanical Garden, at Bronx Park. In these the plants are grouped for convenience of study according to genera, subgenera, and species, under the protection of glass roofs. Other collections, arranged more artistically and under more natural conditions, in the

^a See Coville, Frederick V., "Desert plants as a source of drinking water." Smithsonian Report for 1903, pp. 499-505. 1904.

open air, are those of the University of Arizona, at Tucson, begun by Prof. J. M. Toumey, now of the Yale School of Forestry; and at Riverside, California, under the direction of Mr. A. S. White, who has devoted much time and money to the establishment of a magnificent cactus garden. Smaller collections are those of Prof. E. O. Wooton, at Mesilla Park, New Mexico, and a garden established at Laredo, Texas, by Mrs. Anna B. Nickels, the veteran collector of desert plants.

Mrs. Nickels has contributed much to our knowledge of Cactaceæ and other xerophytes of Texas and northern Mexico. Specimens collected by her are cited in all modern works on Cactaceæ, and many of her notes on their properties, uses, and life history are quoted. On a recent trip to Mexico the writer looked forward to visiting her in Laredo, but found that she was no longer there. Fortunately, he afterwards met her at the home of her son in the city of San Luis Potosi. Though she had left her garden behind her, she was still faithful to the objects of her early love, some of which she had carried with her on her exodus to the patio of her son's house, and there, like Göthe's Waldblümchen, "they blossom on." Nearly every plant growing in her garden she had collected with her own hands. Many of them were from the valley of the Rio Grande, but for some she had made extensive trips into Mexico, often finding it necessary to make long and painful journeys on muleback, and climbing among sharp rocks and along the escarpment of steep mountains where no animal could find foothold. From an economic view the most interesting cactus of her collection was the narcotic mescal button (*Lophophora williamsii*), which she was among the first to bring to the notice of medical men. Her observations as to its use as an intoxicant and febrifuge by the Indians were published by Prof. John M. Coulter in his "Preliminary revision of the North American species of Cactus, Anhalonium, and Lophophora."^a For many years Mrs. Nickels sent valuable consignments of medicinal and other plants of the Mexican boundary region to chemists, manufacturers of drugs, florists, and botanists, both in the United States and Europe.

Another veteran collector to whom the National Herbarium and the Department of Agriculture are greatly indebted for Mexican plants, both living and dried, and for valuable notes on their medicinal properties and economic uses, is Dr. Edward Palmer, who at the advanced age of 78 years is still continuing the work he began in his youth. In the cactus houses of the New York Botanical Garden and the Department of Agriculture at Washington there are many living plants of his collection, the life histories of which are the subject of study by Doctors Britton and Rose; and in the pharmaceutical

^a Contributions to the United States National Herbarium Vol. 3, p. 133. 1894.

collection of the Department are many dried specimens collected by him, of which the medicinal and chemical properties are to be studied by drug experts.

At Monterey, the capital of Nuevo Leon, the writer visited the Lomo del Obispado, on the western edge of the city, crowned by the historic Bishop's Palace, which was used as a fortification during the war between Mexico and the United States. From this hill there is a fine view of the lovely valley in which Monterey lies, with the picturesque Silla, or Saddle Mountain, beyond (pl. 1). Here I collected a number of interesting species, including the cylindrical *Mamillaria leona* (pl. 2, fig. 3), and the conical *M. conoidea* (pl. 14, fig. 1). Other species were the melon-shaped *Echinocactus horizonthalonius* (pl. 2, fig. 5), and the flatter, sharp-ribbed *Echinocactus texensis* (pl. 2, fig. 1). Many of the Echinocacti bear a general resemblance to plants of the genus *Cactus*, usually called *Melocactus*, but lack the cap of felt and bristles by which the latter are crowned (pl. 2, fig. 2). Other interesting plants were the comb-spined *Echinocereus pectinatus* (pl. 2, fig. 6), and *Mamillaria heyderi*, a little hemispherical plant with radiating bristle-like spines. There were also a few specimens of a bushy, slender-stemmed, red-fruited *Opuntia* I had noticed near the railway track in coming from Laredo, chiefly interesting on account of the diaphanous sheaths covering the slender needle-like spines (fig. 12, p. 547).

At the Colegio Civil, where I found a pretty collection of living cacti, I had the pleasure of meeting Prof. Emilio Rodriguez, of the Normal School of Monterey. This gentleman gave me much useful information regarding the principal localities for cactus collecting in the State of Nuevo Leon. Chief among them are Santa Catalina, near the base of the Cerro de la Mitra, a short distance west of the city; Rinconado, a mountain pass between Monterey and Saltillo; Los Muertos, just over the Coahuila line beyond Rinconado; and Icamole, to the northwest of Monterey, near the Coahuila boundary. Professor Rodriguez accompanied me on an excursion to Icamole, where we were the guests of his compadre, Don José Maria Garza Fernandez, an enthusiastic cactus lover, who has on his estate a collection of the principal cacti growing in the State of Nuevo Leon. One of the most interesting was a beautiful and rare little *Mamillaria* with downy plumes instead of spines. This species, *Mamillaria plumosa*, has been confused with *Mamillaria lasiacantha*, which has hairy spines; but it is quite distinct. It occurs on the Cerro del Almendrillo, about 9 miles south of Icamole, and over the boundary line at Los Muertos, in the State of Coahuila. A photograph of its plumes, enlarged $2\frac{1}{2}$ diameters, is shown on plate 3, figure 6. Another interesting species was the pezuña de venado, *Ariocarpus kotschubeyanus* (pl. 3, fig. 4), a small plant with a

rosette of triangular tubercles, each marked with a median suture in such a way as to suggest the cloven hoof of a deer. It is recorded that Baron Karwinski, its discoverer, returned to Germany with only three specimens, one of which he sold for 1,000 francs. It was named by Lemaire in honor of his patron, Prince Kotschubey; though it was afterwards described as *Anhalonium sulcatum*, an appropriate name, but according to the laws of priority not tenable.

A hook-spined plant remarkable for its yellowish-green flowers crowded about the summit proved to be *Echinocactus scheerii brevifloratus* (pl. 3, fig. 3). The outer floral leaves are quite green, the innermost between green and yellow, its anthers yellow, and its stigma bright green. The tube of the perianth is scaly. The fruit is acid, but can be eaten. Another remarkable plant was *Lophophora williamsii*, the mescal button, or peyote, to which I have already referred (pl. 3, fig. 5). Instead of spines, it bears little tufts of wool on its areoles. The tubercles, separated by shallow horizontal grooves, are usually arranged in vertical lines, like a typical *Echinocactus*, but sometimes they are irregular, recalling those of *Echinocactus lophothele*, which I afterwards collected on the neighboring mountains (pl. 3, fig. 1). The prettiest cactus flowers in the garden were those of species of *Echinocereus*, with crimson or purple perianths, yellow stamens, and green stigmas. These plants are called "alicoches" in northern Mexico, and their spiny edible fruits "pitayas." The two most common about Icamole were *Echinocereus conglomeratus*, with long white pellucid needles, and a species resembling *E. stramineus*, with coarser straw-like spines. These two species are erect and grow in groups. There are one or two other species of which the stems are more slender and prostrate or procumbent. One of them, *Echinocereus berlandieri*, is shown on plate 3, figure 2. Another plant of very different habit, formerly classed with the genus *Echinocereus*, was *Wilcoxia poselgeri* (*Echinocereus tuberosus*), with weak, slender stems no thicker than a lead pencil, tuberous roots, and pretty rose-colored flowers with rose-colored filaments, sulphur-yellow anthers, and emerald-green 8-rayed stigma. In northeastern Mexico this plant is called "sacasil," a name which is elsewhere applied to a species of *Boussingaultia*, a climbing plant with tuberous roots belonging to the Basellaceæ. There were no columnar cardones, or organos, in the garden, though I was told that the common organo of the hedges of central Mexico (*Cereus marginatus*) grows at Pezqueria Chica, in the State of Nuevo Leon. *Echinocactus bicolor*, with tubercled ribs and straight spines, is not uncommon in the vicinity of Icamole, but here the spines are not bright colored like those I afterwards found at Parras (pl. 13, fig. 2). *Echinocactus capricornus* (pl. 5, fig. 2) and *Echinocactus cornigerus* (pl. 13, fig. 6), two other species growing in the garden, are also



FIG. 1.—*Echinocactus texensis*.



FIG. 2.—*Cactus (Melocactus) maxonii*.

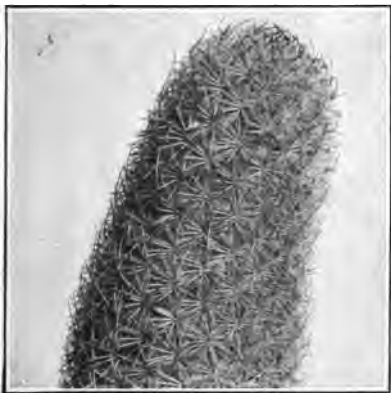


FIG. 3.—*Mamillaria leona*.



FIG. 4.—*Mamillaria pusilla*.



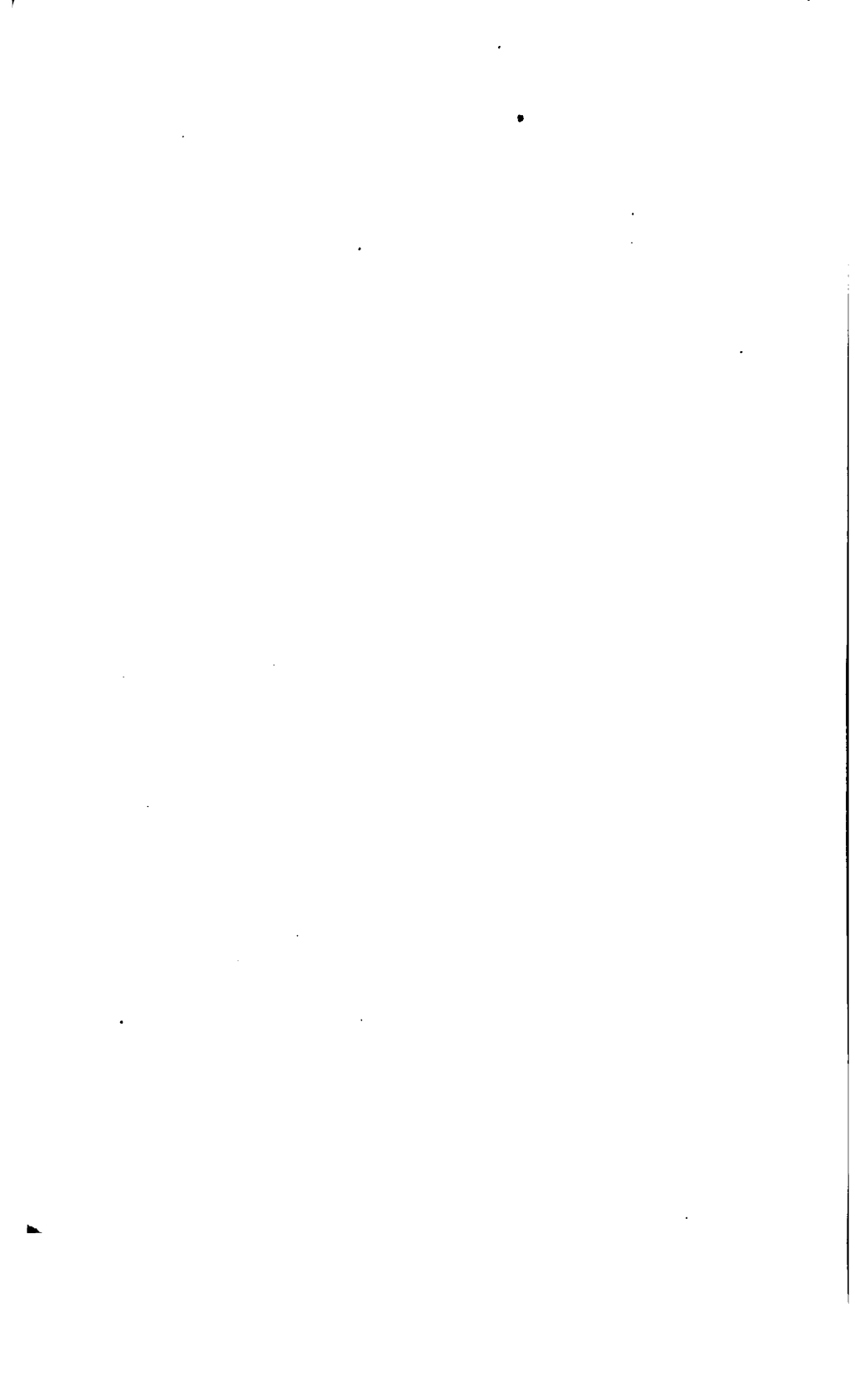
FIG. 5.—*Echinocactus horizontalis*.



FIG. 6.—*Echinocereus pectinatus*.

TYPES OF CACTACEÆ.





indigenous to this locality as well as *Echinocactus longihamatus*, which bears the acid limas de viznaga, used in cooking as a substitute for lemons (pl. 9, fig. 4). *Echinocactus beguinii*, covered with spines so thickly as to resemble a gray sea urchin, had been brought from the Villa de Mina, 25 miles distant from Icamole, and *Echinocactus macdowellii*, resembling a white sea urchin, from the Cañon de Santa Catalina, a short distance southwest of Monterey. *Echinocactus texensis*, locally known as "mancacaballo," or "horse-crippler," has beautifully fringed, feathery, rose-colored petals, while those of the somewhat similar *E. horizonthalonius* are nearly entire, and the bright-red fruit of *E. texensis* usually bears tufts of wool (pl. 2, fig. 1), while that of *E. horizonthalonius* is quite surrounded by wool. Several specimens of *Mamillaria leona* (pl. 2, fig. 3) were in bloom, bearing a few brick-red flowers near the crest of the plant. This color is rare in the Cactaceæ, many of them having rose-colored or crimson flowers, like those of *M. conoidea* (pl. 14, fig. 1), or white, tinged with pink or flesh color, or some shade of yellow, as in *M. bocasana* (pl. 4, fig. 4).

Don José Maria kindly offered to take us to a locality famous for the great numbers of *Echinocactus multicostatus* growing there. He obtained animals and a guide, and we were soon on our way to a mountain range about nine miles farther to the westward. Along the road were thickets of red-fruited tasajillo (*Opuntia leptocaulis*) alternating with the creosote bush (*Covillea tridentata*), and the stouter *Opuntia imbricata* with candelabra-like whorls of tubercled branches and lemon-yellow fruit. This species is locally known as "coyonostli" ("coyote prickly pear"). Afterwards I saw it growing near Durango, where it was called "cardenche." A flat-jointed *Opuntia*, called "cuija," was also common as well as a low pubescent species (*O. microdasys*) without spines, but with tufts of little glochidia, or barbed bristles, which are easily detached and are apt to get into the eyes of animals, often causing serious inflammation and even blindness. For this reason the plant is called "nopalillo cegador," or "blinding little nopal" (pl. 10, fig. 4). Clumps of long-spined *Echinocereus conglomeratus* were frequent. Very different in appearance from these was the dainty little lace cactus, *Echinocereus cespitosus* (pl. 4, fig. 6), a low, cylindrical plant covered with appressed pectinate white spines so soft that the plants could be handled with impunity. The flowers of this little plant are so large that Don Manuel Fraile, an enthusiastic cactus lover, has christened them "merry widows," a name applied to the large, spreading hats recently in vogue among the ladies of the United States. Reaching our destination, we bivouacked for the night under a cloudless sky. Our camp was at the head of the Cañon de las Barretas, so named

from a thicket of barreta bushes (*Helietta parvifolia*) growing farther down the slope. The most characteristic plants of the country through which we had come were the gobernadora, or creosote bush (*Covillea tridentata*); candelilla (*Euphorbia antispyphilitica*), with rigid vertical wax-covered leafless stems; the green thorny leafless junco (*Koeberlinia spinosa*); sotol (*Dasylirion texanum*), with remotely toothed bayonet-shaped leaves; pita samandoque (*Hesperaloe funifera*), with the margins of its linear leaves bearing loose fibrous threads; and the low, rigid, sharp-leaved agave called lechuguilla, which yields much of the commercial fiber from northern Mexico.

On the very crest of the mountain range, growing in little rock pockets, we found *Echinocactus multicostatus* (pl. 4, fig. 3), the object of our search, scores of plants, with many sharp radiating ribs which look like accordion plaiting. This plant belongs to a group in which there is considerable variation of the spines. Farther south, near Saltillo, I collected plants apparently of this species, but with stouter spines, and near Aguascalientes a form with spines so numerous and broad as almost to conceal the flower (pl. 4, fig. 5). On the mountain crest associated with this plant was a rosy-flowered composite (*Pinaropappus roseus*), a pretty little daisy-like flower (*Chaetopappa modesta*) with blue-tinted rays which were just closing in sleep, and *Menodora coulteri*, sometimes called "mountain jasmine," with yellow flowers like rockroses (*Helianthemum*). Characteristic shrubs were a barberry (*Berberis trifoliolata*), sometimes called "paloamarillo," from its wood, which yields a yellow dye, or agritos, from its acid berries; an Acacia (*A. berlandieri*) with white odorless flowers, called "huajillo" in northern Mexico; the chapote prieto, or black persimmon (*Brayodendron texanum*); and a little farther down *Sophora secundiflora*, a bush with clusters of blue wistaria-like flowers having the odor of ripe grapes and followed by scarlet-seeded pods called "frijolillos," or "colorines."

It was pleasant to see the affection with which our host seemed to regard each little cactus plant. One of them from which the root had been broken had been thrown aside and was lying on a bare rock. He knelt down and carefully replanted it in a crevice, putting a handful of black soil about its base, saying: "*Pobrecita, déjela que viva!*"

Farther down the mountain side I collected a tiny *Mamillaria* (pl. 4, fig. 2), with a delicate hooked central spine on each areole surrounded by a number of spreading radials. It was very probably *Mamillaria carretii*, a species closely allied to *M. bocasana*; but that species has more than one hooked central and spreading wool-like hairs growing from each areole (pl. 4, fig. 4). Other species collected here were three *Echinocacti*, already mentioned—*E. horizon-*



FIG. 1.—*Echinocactus lophothele*.



FIG. 2.—*Echinocereus berlandieri*.



FIG. 3.—*Echinocactus brevihamatus*.



FIG. 4.—*Ariocarpus kotschubyanus*.



FIG. 5.—*Lophophora williamsii*.



FIG. 6.—*Mamillaria plumosa*. X 24.

TYPES OF CACTACEÆ GROWING IN NUEVO LEON.



FIG. 1.—*Mamillaria greggii*.



FIG. 2.—*Mamillaria carretii*.



FIG. 3.—*Echinocactus multicosatus*.

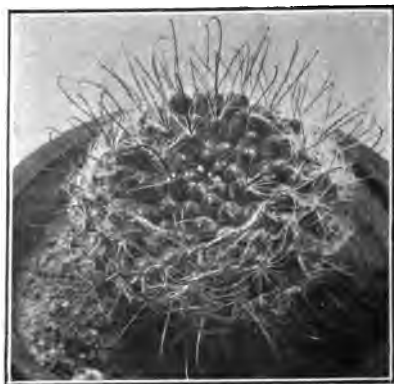


FIG. 4.—*Mamillaria bocasana*.



FIG. 5.—*Echinocactus crispatus*.



FIG. 6.—*Echinocereus caespitosus*.

thalonius, *E. longihamatus*, and *E. lopothele*. Very closely allied to the last is a form collected by Mathsson, in the Rinconado Pass, between Saltillo and Monterey, named *Echinocactus rinconadensis*.

On our return trip we collected the glass-needled alicоче (*Echinocereus conglomeratus*), and the pretty little button-cactus *Mamillaria greggii* (pl. 4, fig. 1), a species very closely allied to *M. micromeris* of Texas. Like many of its congeners it bears little crimson club-shaped chilitos, which are relished for their pleasant acidulous, cranberry-like flavor. When we reached the hacienda Don José Maria insisted on adding to my collection some of the rarest species of his garden. I offered to pay for them, for I knew that he sometimes sold plants to dealers, but he declined with polite dignity to receive money, saying: "No, Señor; that would spoil all my pleasure. If I might ask a favor, however, I beg that you send me a few books which treat of Cactaceæ, books with pictures, for I can not read English nor German, and I have only this catalogue to guide me. I have some idea of the various groups of plants, but it is sometimes hard to distinguish a Mamillaria from an Echinocactus, though I know that in general the Mamillarias bear chilitos, and the Echinocacti have scaly fruits. I know of no book in Spanish to help a cactus lover, though this is the country of the Cactaceæ. Ah, Señor, what a great help illustrations are!"

I accepted Don José Maria's plants with thanks, and told him that I would try to prepare a guide to the study of Mexican Cactaceæ, such as might help an amateur collector, explaining by figures, as well as possible, the differences between the genera, describing the flowers, the structure of the plants, and the uses to which many of them are applied.

It will not be possible within the limits of the present paper to enumerate all the plants collected and observed during my recent Mexican journey. In the vicinity of Saltillo I collected many of the same species as in Nuevo Leon, including the strange-looking *Echinocactus capricornus*, with tufts of twisted spines and beautiful flowers (pl. 5, fig. 2), *Lophophora williamsii*, *Mamillaria leona*, *M. conoidea*, *Echinocereus conglomeratus*, and the species resembling *E. stramineus*. In addition to these was a species of *Ariocarpus* (*A. furfuraceus*), locally known as "chautle," which is quite distinct from *A. retusus* (also known as *A. prismaticus*), a species I saw in the Monterey collection, though the two species are held by some authorities to be identical.^a

In the vicinity of Parras, Coahuila, in addition to many of the same species as those I had already collected, I found a species of *Ariocarpus* (pl. 5, fig. 1) very closely resembling the well-known "living

^a Schumann. Karl. Op. cit., pp. 605-606.

rock" (*Ariocarpus fissuratus*), growing on the hills of Perote. *Echinocactus* (*Astrophyton*) *capricornus* (pl. 5, fig. 2) was also common in this locality. A variety of *Echinocactus bicolor* (pl. 13, fig. 2) had its spines most brilliantly variegated with red and yellow; and a hooked-spined *Echinocactus* (*E. uncinatus*) bore a close resemblance to *E. longihamatus*, except that the flowers were purplish instead of yellowish, the spines were more dense, and several centrals were hooked instead of a single one. A distinction was here made between two species of *Echinocereus*, apparently *E. conglomeratus* and a species with very long bluish spines. The first was called "pitahaya de Agosto," because the fruit at this place ripens in August, and the second was called "pitahaya de San Juan," because the fruit is expected to be ripe on Saint John's Day (midsummer). A cylindrical *Opuntia*, called "coyonostli," was apparently *O. imbricata*, which I had already collected; but a second more slender-branched species, bearing the name of "tasajillo," was quite distinct from the Monterey tasajillo, since its fruit was orange-colored instead of red and its branches somewhat stouter. A little *Echinocereus*, related to *E. pectinatus*, had its spines prettily colored in such a way as to form zones of red and straw color, from which it has been named "rainbow cactus."

It gives me great pleasure to acknowledge here the courtesy extended to me by the Madero family during my stay at Parras, and the kindly assistance of Dr. Alfred Walther, at whose house I found Förster's *Handbuch der Cacteenkunde*, edition of 1892, illustrated by a number of excellent woodcuts. Doctor Walther had established a small collection of living cacti in the principal plaza of Parras. Among the most interesting were *Cephalocereus senilis*, called *cabeza de viejo*, or "old man's head," from the gray hair growing from its crest (fig. 15, p. 552); *Echinocactus* (*Astrophytum*) *myriostigma*, the *birreta de obispo*, or "bishop's cap," from Cerravola, a short distance west of Parras; the closely allied *E.* (*Astrophytum*) *capricornus* from a barranca just south of Parras (pl. 5, fig. 2); *Echinocactus pilosus*, sometimes 4 feet high and 2 feet in diameter, with ruby-red spines and white, radiating, twisted string-like hairs; *Echinocereus caespitosus* (rainbow variety), and *Mamillaria leona*, from Llanitos, 9 miles east of Parras; the remarkable *Mamillaria cirrhifera longispina*, covered with long, tangled spines like coarse, wiry hair, from the barranca behind the neighboring Capilla; and the well-known chilito-bearing *Mamillaria meiacantha*, with pyramidal tubercles and short spines.

But the most interesting cactus of this region from a botanical point of view is *Leuchtenbergia principis* (fig. 23, p. 559) from Pata Gallina, a short distance to the southeastward of Parras, where it grows in company with *Mamillaria scheerii* and *Opuntia cereiformis*.



FIG. 1.—*Ariocarpus fissuratus?*



FIG. 2.—*Echinocactus (Astrophytum) capricornus.*



Fig. 1.—*Hylocereus trilostatus*.

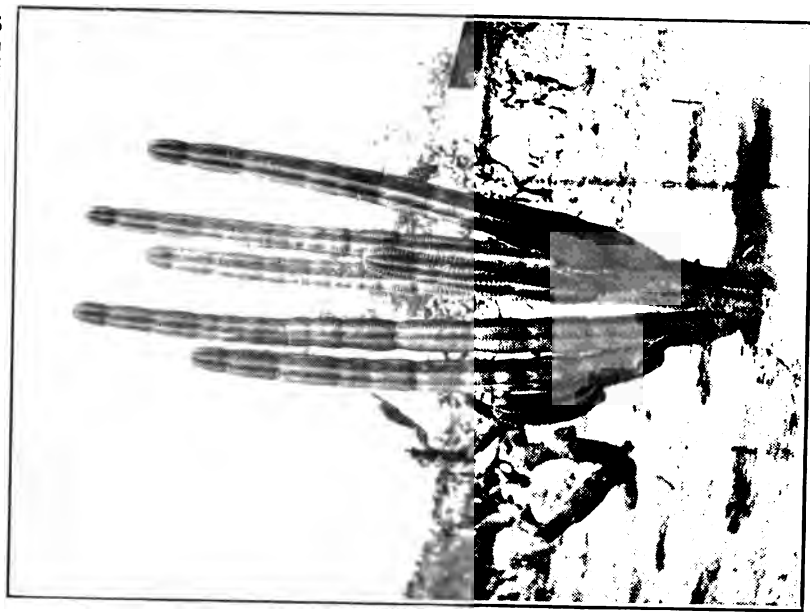


Fig. 2.—*Lemaitreocereus quercifolius*.
TYPES OF *CEREUS* CULTIVATED AT GUADALAJARA.

The latter species is an interesting cylindrical *Opuntia* belonging to the series *Clavatæ*, in which the spines are not sheathed in scabbards. Another species of this group is *Opuntia bulbispina*, from Perros Bravos, north of Parras, where it was collected by Doctor Gregg in 1848. Its flowers and fruit have never been described.

In addition to the cacti, there were several other xerophytes; among them an agave with remarkably short and broad leaves, called "noa," from a locality 18 miles east of Parras, on the road to Mezquite; a very narrow and rigid leaved agave, called "palmillo," from the Barranca de Llanitos, 9 miles east of Parras; and a species of *Dasyllirion*, called "sotol," the crowns of which are used, like those of an agave, for making a fermented drink.

At Aguascalientes I collected several sheath-spined *Opuntias*, including the coyonostli (*Opuntia imbricata*) and the low clavellina (*Opuntia tunicata*) (pl. 10, fig. 5). Of the latter species my guide seemed to have a horror. He would repeatedly warn me: "Be careful, Señor; do not touch it; it is *muy bravo*, a plant of the devil." And, indeed, it seemed fairly to leap in eagerness to sink its barbed spines into the flesh of the unwary passer-by. The spines are easily withdrawn, but the barbed scabbards remain to fester, and can only be extracted with difficulty. On the hills above the hot springs at Aguascalientes I found only two other cacti. One, *Mamillaria uncinata*, was a low flat-topped species growing among the grass, with a single stout claw-shaped central spine, surrounded by a number of radials, and with white petals, bearing a median stripe of pink. The other was an *Echinocactus* to which I have already referred (*Echinocactus crispatus*?) (pl. 4, fig. 5), closely related to *E. multcostatus*, but with many broad, sword-shaped spines converging about the apex and almost concealing the flower.

At Guadalajara I had the pleasure of meeting Dr. Adrian Puga, to whom I am indebted for many courtesies. Through his kindness I obtained specimens of at least two species of *Pereskia*, cacti related to the *Opuntias*, but resembling the genus *Pereskia* in having well developed leaves (pl. 10, fig. 2). One of these species, *Pereskia aquosa*, bears edible watery fruit called "tunas de agua." Another interesting plant was a *Nopalea* (probably *Nopalea karwinskiana*) with beautiful rose-colored flowers, locally known as "*nopalillo de flor*." In *Nopalea*, an *Opuntia*-like genus including the plant upon which the cochineal insect is reared, the floral leaves are erect, instead of spreading as in *Opuntia*, and the stamens are longer than the perianth but shorter than the style (see fig. 14, p. 549). In the gardens of Guadalajara several species of climbing triangular *Cerei* are cultivated, all of which bear edible fruit called "pitahayas." One species has recently been described as new under the name *Cereus tricostratus* (pl. 6, fig. 1). In addition to these I noticed a columnar

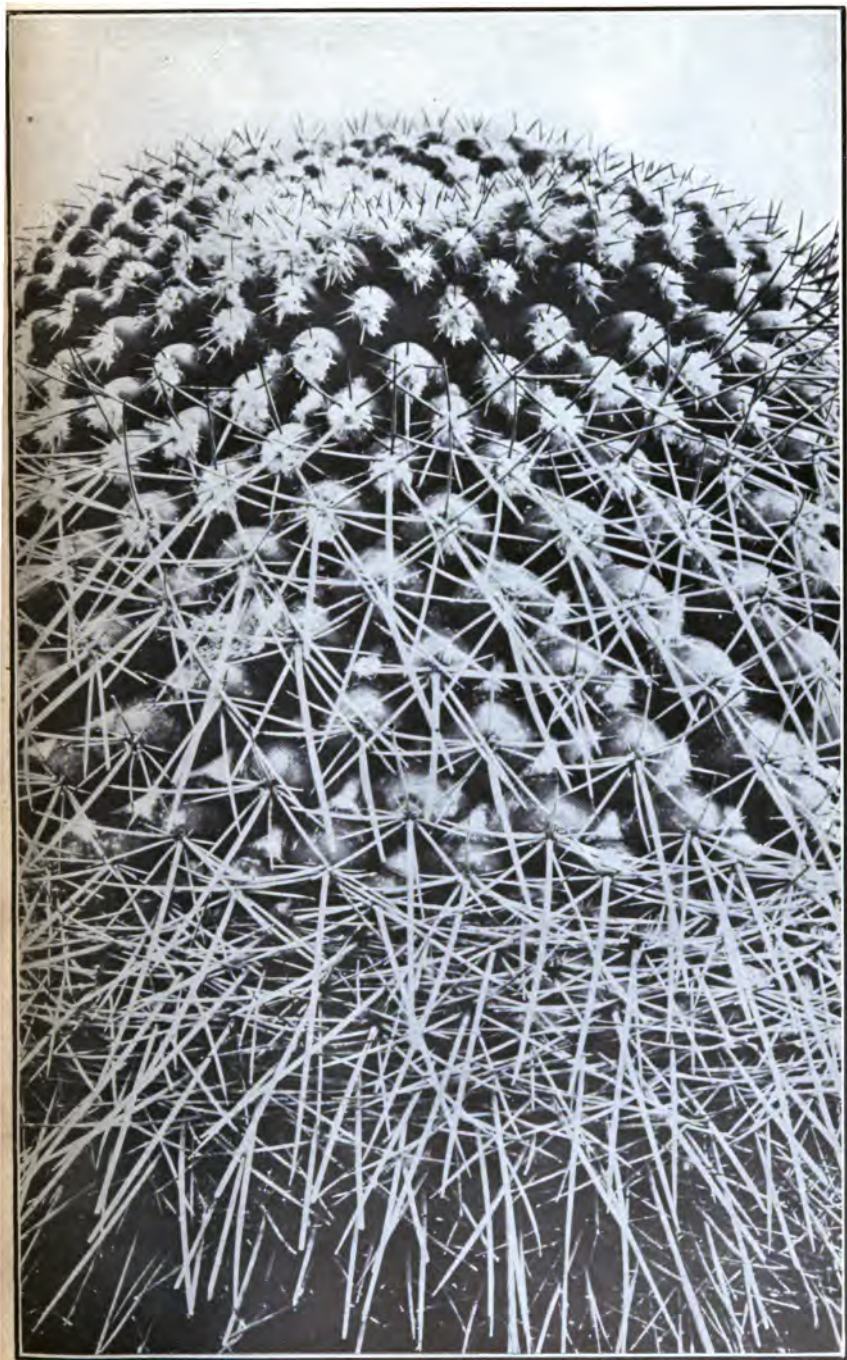
cardon, *Cereus queretarensis* (pl. 6, fig. 2), which is much planted in southern Jalisco and Querétaro.^a At Guadalajara the natives make a distinction between the edible spiny fruit of the cardon, which they call "pitaya," and that of the climbing triangular Cerei, which they call "pitahaya." In the markets I saw a milky *Mamillaria* offered for sale for medicinal purposes. Milky *Mamillarias* are popular remedies in many parts of Mexico. In Durango the milk is used for healing cracks in the feet of the natives; elsewhere it is administered internally for various purposes.

At Guanajuato it was my privilege to meet the venerable Prof. Alfredo Dugès, so well known to the students of Mexican natural history as an accomplished botanist and zoologist. Accompanied by his collector, I climbed about the hills surrounding the city and collected several interesting cacti. In the hedges, beside the common columnar organ cactus (*Cereus marginatus*) (pl. 11, fig. 2) and the branching garambullo (*Myrtillocactus geometrizans*) (pl. 11, fig. 1), I found *Cereus queretarensis*, to which I have already referred. Here it is distinguished from the organo under the name pitahaya. Garambullo, the common name of *Myrtillocactus geometrizans*, is applied to various small currant-like fruits in Mexico.^b The fruits of this species (pl. 9, fig. 2) are eaten either fresh or dried like raisins. On the steep dry hills of Guanajuato I collected two or three interesting milky *Mamillarias*, including the long-spined *M. metrizans*, is applied to various small currant-like fruits in Mexico.^b species resembling *M. gigantea*, but not flat, as that species is described to be. In the hedges I noticed several slender-stemmed Cerei, including *Aporocactus flagelliformis*. The beautiful rose-colored flowers of this species are zygomorphous instead of perfectly regular. They are extensively used medicinally in Mexico under the name "flor del cuerno," or "horn flower" (fig. 18, p. 555).

While in the City of Mexico I was the guest of Mme. Zelia Nuttall, the archeologist, at her beautiful home, Casa Alvarado, an ancient villa situated near Coyoacan not far from the celebrated Pedregal, or lava beds. The garden of Casa Alvarado, which is several centuries old, has a number of most beautiful and interesting trees and shrubs, including a rose bush with a stem 10 inches in diameter, several conifers, and lofty palm-like yuccas. On the terrace grew beautiful cacti in pots, including cylindrical and triangular Cerei and rare *Mamillarias*, and over the artistic pergola spread various climbing bright-flowered Bignonias. Accompanied by one of her men I visited the Pedregal, a mass of broken angular blocks of lava, here and there perforated by great bubbles or blowholes. Every-

^a See Mathsson in *Monatsschrift für Kakteenkunde*, Vol. 1, p. 28, 1891.

^b In Sonora the small yellow fruit of *Momisia pallida* is called *garambullo*.



MAMILLARIA HEESIANA (NATURAL SIZE).





PLATE 8.



thing was parched and dry at this season, and the area had been burned over, the guide said, to destroy the "infernál" *Opuntia tunicata*, the same species I had collected at Aguascalientes (pl. 10, fig. 5). Here it is called abrojos, a name applied to various spiny plants in Spain and Mexico, signifying "caltrops."

On visiting the Instituto Medico of the City of Mexico I had the pleasure of meeting Prof. Gabriel V. Alcocer, who kindly presented me with a copy of the valuable *Sinonomia Vulgar y Científica de las Plantas Mexicanas*, a work to which he contributed as collaborator of the late Dr. José Ramirez. It was a great disappointment to me to find that little effort had been made to form a collection of living Cactaceæ at the Instituto Medico. At the Museo Nacional I purchased a catalogue of the phænogamous plants in the herbarium of the museum, published in 1897 by the late Doctor Urbina. This work has been of great assistance to me, but it contains the names of only four cacti, all collected by Mr. C. G. Pringle. In the garden of the museum there was a collection of living cacti, scarcely any of which had been identified. I had the pleasure of meeting Don Manuel Urbina, the son of the celebrated botanist, who kindly presented me with a number of his father's botanical papers, including his monograph on the peyote, published in the *Anales del Museo Nacional*, volume 7, pages 25 to 48, 1900.

To my great regret I was obliged to start northward without visiting the wonderful cactus region of Tehuacan, in southern Puebla.

On the way from Mexico City to San Luis Potosi I passed through the country of the giant viznagas from which viznaga dulces are made. Several species are used for this purpose, the principal one being *Echinocactus ingens*. At several stations I saw specimens of these great barrel-shaped or globular plants awaiting transportation. They were in pairs, having been carried from the mountains on mule back, one strapped on each side of the animal. The rigid penetrating spines had been removed before they were started on their way to market, and consequently it was impossible to tell with certainty to what species they belonged.

At San Luis Potosi I found myself in the great tuna market. It was winter and the only tunas on sale were the deep purple, or beet-colored, tuna chaveña, usually peeled ready for eating, and the acid tuna xoconochtli, with a yellowish-pink rind, not eaten by itself but used like lemons to season dishes which would otherwise be insipid. One of the most important food staples in the market was the queso de tuna, or "tuna cheese," usually made from the celebrated tuna cardona, but sometimes also from tuna pachona, the latter being easily distinguished by its deep red color, while the former is of a

brownish yellow, with the taste of molasses candy, and of a soft pasty consistency. But the subject of the tuna as a food staple has been so ably discussed by others, that I will not here repeat what has been already said.^a

Near the city of San Luis Potosi is situated the Cerro de Peotillos, one of the localities celebrated for centuries as a collecting ground for the narcotic peyote, or mescal button (*Lophophora williamsii*), to which I have already referred (pl. 3, fig. 5). To this hill and to Real de Catorce, farther north, the Huichol Indians of the mountains of northern Jalisco used to resort annually to obtain their supply of peyote, which was regarded by them with superstitious veneration.^b The natives of San Luis Potosi do not use it as a narcotic, but value it as a remedy for fevers. Another curious little cactus (*Pelecypora aselliformis*) (pl. 14, fig. 6), called "peyotillo," or "peotillo," has similar virtues attributed to it, and is sold in the drug markets of the city. Many species of cactus have been collected in the vicinity of San Luis Potosi, by Palmer, Pringle, Purpus, and other collectors; but it will be impossible to enumerate them in this paper. One of the most interesting is a large viznaga, *Echinocactus palmeri* Rose (pl. 13, fig. 1), specimens of which I saw growing on the hills about the presa, or reservoir, from which the city receives its water supply. This plant, commonly known as *Echinocactus saltillensis*, was rechristened by Doctor Rose, whose figures I here reproduce (pl. 8), because the specific name *saltillensis* had previously been applied to another species of the genus.^c Closely allied to this are the giant viznaga of southeastern Puebla, *Echinocactus grandis*, common between Tehuacan and Esperanza; *E. ingens* of Queretaro; *E. viznaga* of San Luis Potosi; and *E. wislizeni* of Arizona, from which dulces are made.

While at San Luis Potosi I had the pleasure of meeting Don Javier Espinosa y Cuevas, owner of the celebrated Hacienda de Angostura, at which, in 1878, Doctors Parry and Palmer were guests while making their collection of Mexican plants, and where later Mr. C. G. Pringle was entertained.^d I met also Don Octaviano Cabrera, president of the Centro Agricola de San Luis Potosi, and the distinguished Don Luis Cuevas, to whom I am indebted for many favors. It gives me pleasure to mention the courtesy of a young

^a See Palmer, Edward. Opuntia Fruit as an article of Food. West American Scientist, Vol. 6, p. 67. 1889.

Griffiths, David, and Hare, R. F. The Tuna as Food for Man. Bur. of Plant Industry Bul. No. 116. 1907.

^b See Diguët, Leon. La Sierra de Nayarit et ses Indigènes, p. 55. 1899.

^c Contr. Nat. Herb., Vol. 12, p. 290, pl. 23. 1909.

^d Pringle, C. G. Notes of Mexican Travel. Garden and Forest, Vol. 6, p. 182. 1893.

Mexican gentleman, Don José Artolózaga, who invited me to accompany him on an expedition to the magnificent presa of San Luis Potosí, of which I have spoken above.

I shall now attempt to give a short account of the Cactaceæ in general, their geographical distribution, wonderful adaptation to various conditions of soil and climate, their vegetative and floral characteristics, and the economic uses to which many of the species are applied.

GEOGRAPHICAL DISTRIBUTION OF CACTACEÆ.

The Cactaceæ are almost entirely confined to America, the only exception being the genus *Rhipsalis*, the plants of which are epiphytes, with pellucid, glutinous berries, many of them resembling rather mistletoes than cacti. It is quite possible that they may have been disseminated, like mistletoe, through the agency of birds.

Several prickly pears introduced at an early date into Europe and Africa have established themselves on both sides of the Mediterranean, and more recently in south Africa; and in certain regions of Australia introduced species are crowding out the indigenous vegetation to such an extent that they have come to be regarded as pests. It is quite common to regard all cacti as tropical or semitropical, but there are a number of species which withstand the frosts of winter. At least two *Opuntias* extend northward into British Columbia,^a and species of *Echinocereus*, *Echinocactus*, and *Mamillaria* are included in the flora of Colorado.^b

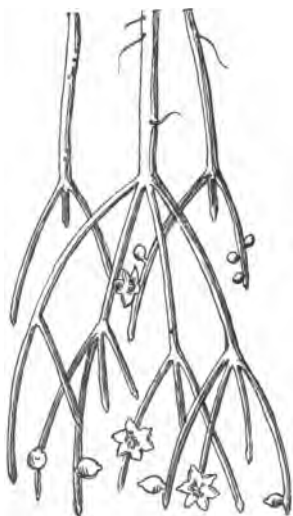


FIG. 1.—Mistletoe cactus (*Rhipsalis cassythæ*).

For a comprehensive account of the vegetation of the deserts of our southwestern States and of Mexico the reader is referred to Professor Frederick V. Coville's *Botany of the Death Valley Expedition*, published as volume 4 of the *Contributions from the United States National Herbarium*, 1893; and to Dr. D. T. MacDougal's "*Botanical Features of North American Deserts*," Publication No. 99 of the Carnegie Institution of Washington, 1908.

To the southward the family extends to Chile and Argentina. Giant torch thistles and Echinocacti are scattered over the pampas

^a See Piper, C. V. *Flora of the State of Washington*, p. 396. 1906.

^b See Rydberg, P. A. *Flora of Colorado*, p. 237. 1906.

of Uruguay, and melon-shaped *Echinopses* amid the snow and hail of the lofty Bolivian plateau. It is interesting to note that the genus *Mamillaria*, so well represented in Mexico, is practically absent from Costa Rica and the countries adjacent to it, the genera representing the family in that region being *Cereus*, *Pereskia*, *Pereskiopsis*, *Nopalea*, and *Opuntia*. These genera also occur in the warm Huasteca region of northern Veracruz and southern Tamaulipas, which is connected with San Luis Potosi by the Mexican Central Railway. *Melocactus* (or *Cactus*, as the genus is now called by Dr. J. N. Rose) is essentially West Indian and Central American; and the genus *Rhipsalis* referred to above, also occurring in tropical America and the West Indies, extends to Africa, the island of Mauritius, and even to Ceylon.

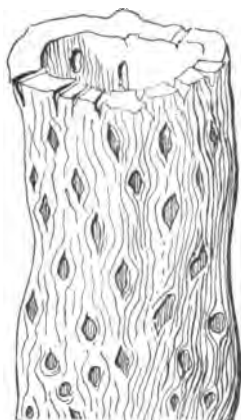


FIG. 2.—Skeleton of an *Opuntia*.

STRUCTURE.

The Cactaceæ have a woody axis more or less pronounced, usually surrounded by pulpy cellular tissue (parenchyma), in which water is stored. The transpiring surface is much reduced and the stomata are usually situated in depressions or grooves in the leathery cuticle of the stem. As an additional means for checking transpiration the cell sap is nearly always mucilaginous, and in some genera there are latex ducts filled with milky or gummy fluid. Certain species of *Echinocactus* (pl. 8) are like great melons or barrels and are filled with pulp of the consistency of watermelon rind.^a On the other hand, the stems of certain *Pereskias*, *Pereskiopses*, and *Opuntias* become quite hard and woody. The hard, woody, reticulated skeletons of several species of *Opuntia* are used for various purposes, such as the manufacture of napkin rings, walking sticks, table and chair legs, and even for veneering. In some parts of South America and in Lower California, where other vegetation is lacking, the stems of cardones, or columnar *Cerei* are used by the natives in constructing their habitations, corrals for their animals, and even in timbering mines, and of some species the stems are dried and soaked in pitch for use as illuminating torches. Many species have tuberous roots. One of these, *Opuntia megarrhiza*, collected by Doctor Palmer at Alvarez, in the State of San Luis Potosi, is sold

^a For an account of the transpiration, root systems, and structure of *Carnegiea gigantea*, *Echinocactus wislizeni*, and *Opuntia versicolor*, see Cannon, W. A., "Biological relations of certain cacti," Desert Botanical Laboratory publications No. 11, reprinted in the Amer. Naturalist, Vol. 40, January, 1906.

in the markets of Mexico under the name of "raiz de nopal," for use in setting broken bones, the drug venders declaring that it will cause the bones to knit speedily.

LEAVES AND AREOLES.

All cacti have leaves, though in some species they are rudimentary, or rather vestigial, and so small that they can not be seen with the naked eye. In others they are large and perfectly developed, either with petioles and feather veins, as in *Pereskia aculeata* (fig. 10, p. 545), sessile and fleshy, with only the mid nerve or several parallel nerves indicated, as in certain species of *Pereskia* (pl. 10, fig. 2), or cylindrical, or awl-shaped and caducous, as in the genera *Opuntia* and *Nopalea*.

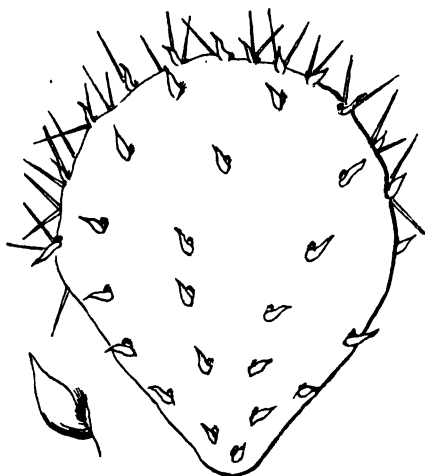


FIG. 3.—*Opuntia* joint, with leaves.

In the axils of the leaves are situated the areoles. These are little cushions clothed with down or felt-like wool from which the spines issue, and in some genera the flowers also. In *Opuntia* and *Pereskia*, in addition to the spines, they usually bear a tuft of small, short, barbed bristles, called glochides or glochidia.

SPINES.

The spines are not connected with the woody axis of the stem or branches, but emerge from the areoles, as indicated above. In some species they are simple and straight, either bristle like, awl-shaped, or short and conical. In others they are bent like fishhooks or curved and horn-like, with transverse ribs (pl. 13, fig. 6). Sometimes they are minutely pubescent

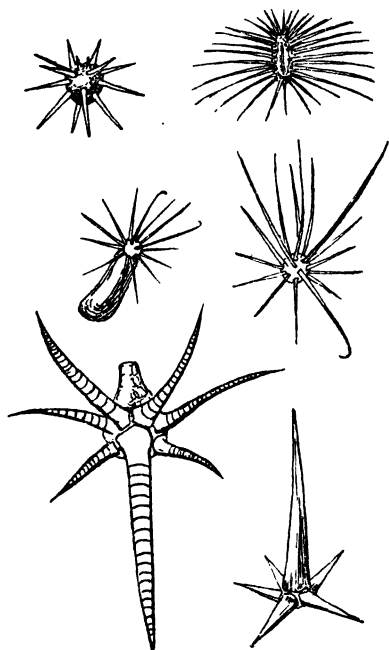


FIG. 4.—Cactus spines.

or hairy and sometimes even plumose or feathery (pl. 3, fig. 6). They may be grouped in star-like clusters, with straight or curved

rays spreading from a common center (pl. 9, fig. 1), or in pectinate fascicles with the radial spines arranged in two rows on each side of a longitudinal axis (pl. 2, fig. 6). In addition to the radial spines, there are usually erect or projecting central spines, either straight and rigid or curved. One of the most striking arrangements is that of spines of *Myrtillocactus geometrizans*, in which the central spine resembles the blade of a dagger and the radials a guard for the hilt (fig. 4, p. 539).

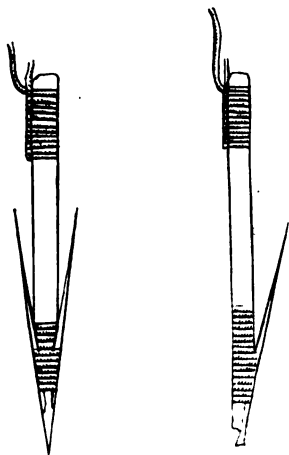


FIG. 5.—Cactus-spine fishhooks.

Cactus spines have been utilized by primitive tribes for various purposes. Dr. Edward Palmer has described the manufacture of curved fishhooks from the spines of a certain *Echinocactus* by the Mohave Indians of the Colorado River.^a Fishhooks with straight shanks of bone and barbs of cactus spines were dug up by the writer from prehistoric graves at Arica, on the coast of Chile, in 1887. They were associated with other articles made of cactus spines, such as needles and combs. In December, 1891, the writer assisted at the opening of several other graves at Iquique, on the same coast, in which not only hooks and needles of the same description were found, but interesting examples of the application of cactus spines to the mending of slits in sealskins which had been used for covering the graves. In these the spines were stuck like awls through both margins and allowed to remain with the ends projecting. Around the ends thread had been passed in a zigzag manner and drawn tight, thus closing the slits tightly and effectively.

FLOWERS.

In most genera the flowers issue from the upper part of the areoles, but in some species of *Mamillaria* and allied genera they grow from between the mammillæ, or from near their base at the end of a groove extending backward from the areole. Usually they are solitary and sessile, but in the genus *Pereskia* they are peduncled and clustered. In nearly all genera they are conspicu-

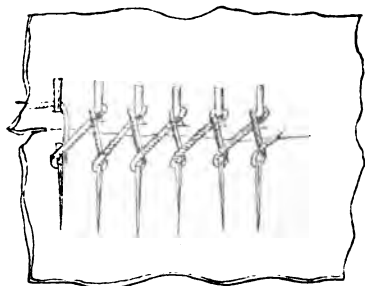


FIG. 6.—Leather repaired with cactus spines.

^a See *American Naturalist*, Vol. 12, p. 403. 1878.

ously colored in tints of rose, crimson, purple, yellow, orange, or copper color, and sometimes scarlet. Often they are pure white, gradually becoming suffused with rose color in age. In a few species they are comparatively sober tinted, and sometimes almost concealed beneath the spines of the plant, and in some cases they are small and inconspicuous, as in the epiphytal *Rhipsalis*. Some are diurnal, others nocturnal; some open at sunrise and close at night or when the sky is clouded; others open at a certain hour and close at a certain hour of the day or night; some last for several days, some for a day, and some for only a few hours.

The flowers of Cactaceæ do not possess a well-defined calyx and corolla, although the outer floral leaves are often quite sepal-like and the inner ones true petals. In one great division of the family,

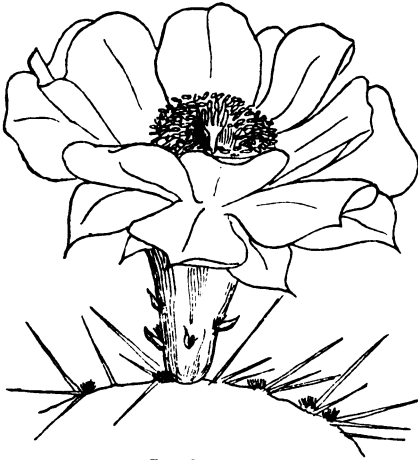


FIG. 7.—*Opuntia* flower.



FIG. 8.—Flower of *Cereus*.

which has been named *Rotatifloræ*, they are widely spreading and wheel shaped, as in the genus *Opuntia*; in the other division, *Tubulifloræ*, to which *Cereus* belongs, the floral leaves form a tube, often remarkably long and slender, crowned with a spreading limb. The floral leaves are not arranged in definite series, but form a spiral in which the scale-like lower bracts gradually assume a sepal-like appearance and at length become broad and petaloid. In all cases the perianth crowns the ovary, and often after withering it persists as a crown to the fruit. The stamens are numerous and are inserted on the petals or perianth tube. The style is more robust and longer than the filaments. It usually expands at the summit and bears a stigma divided into several or many rays. Sometimes the stigma is brightly colored and looks like a star issuing from the dense cluster of anthers, adding no little to the beauty of the flower. This is especially the case in certain species of *Echinocereus*, having the bright yellow or orange-colored stamens surmounted by an emerald-green, star-like stigma and surrounded by petals of rich rose purple.

The ovary, though formed of several carpels, is always one celled. The placentæ are parietal and bear an indefinite number of anatropous ovules. In some genera (*Opuntia* and its allies) the funiculi, or ovule stalks, become thick and fleshy as the seeds develop, and finally form a more or less sugary pulp in which the seeds are imbedded.

FRUIT.

Pereskia has a fruit somewhat like an apple in shape with a number of leafy bracts on the skin,^a so that in the Dutch West Indies the fruit of *P. aculeata* is called "blad-appel," or "leaf apple." In the British islands it is known as the Barbados gooseberry, and is used for making tarts and sauces, very much after the manner of true gooseberries. In some of the *Pereskioptes* the fruit is elongated and opuntia-like with a watery rind, as in the tunas de agua of Guadalajara, and with seeds covered with cottony hairs. In *Opuntia* and *Nopalea* the fruit is a tuna (in the ancient Nahuatl, called "nochtli"). Tunas are set with areoles like the stems or joints of the plant itself, and when immature bear leaves (pl. 10, fig. 6). These eventually fall off leaving little tufts of barbed bristles or glochidia in their axils (pl. 9, fig. 6). Many species of the genus *Cereus* and its allies bear edible fruit. Those of the tall columnar cardones, called pitahayas,^b are often covered with tufts of wool and spines, which are detached easily when the fruit is ripe, leaving it covered with scars (pl. 9, fig. 5). The triangular forms of *Cereus* usually bear edible pitahayas also (see pl. 12), some of them of enormous size and delicious flavor, and in Texas and northern Mexico several long-spined alicoches (*Echinocereus* spp.) are known to Americans as "strawberry cacti," from the delightful flavor of their succulent berries (pl. 9, fig. 3). I have already referred to the acid limas de viznaga, as the fruit of *Echinocactus longihamatus* is called in Nuevo Leon (pl. 9, fig. 4), as well as to the smooth red chilitos borne by various *Mamillarias* (pl. 9, fig. 1) and the currant-like garambullas of the arboreal *Myrtillocactus geometrizans* (pl. 9, fig. 2). Very much like the fruit of a *Mamillaria* is that of the genus *Melocactus*, in some species of which the little chilitos issue from the crown like scarlet radishes or crimson firecrackers tipped with a fuse (pl. 1, fig. 2).

The seeds of Cactaceæ vary considerably in the different groups and are sometimes useful in making generic determinations. In *Pereskia* they are comparatively small with a thin black glossy testa, or

^a See Rose, J. N. Contr. Nat. Herb., vol. 12, p. 399, pl. 54. 1909.

^b In Central and South America the name tuna is sometimes applied to fruits of *Cereus*.



FIG. 1.—*Mamillaria heyderi*.

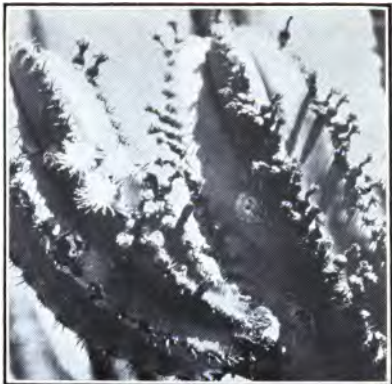


FIG. 2.—*Myrtillocactus geometrizans*.



FIG. 3.—*Echinocereus dubius*.



FIG. 4.—*Echinocactus longihamatus*.



FIG. 5.—*Lemaireocereus griseus*.



FIG. 6.—*Opuntia streptacantha*.

EDIBLE FRUITS OF CACTACEÆ.



shell. In *Pereskioipsis* they are covered with matted hairs or cotton. In *Opuntia* and *Nopalea* they are flat, hard, and bony, often margined and more or less ear-shaped in flat-jointed *Opuntias* (fig. 9^a), or discoid and marginless, as in many cylindrical-jointed *Opuntias* (fig. 9^b). In *Cereus* they are glossy black, either quite smooth or finely pitted (fig. 9^c), while in *Echinocereus* they are covered with minute tubercles (fig. 9^d). In *Echinocactus* they are pitted in some species and tuberculate in others. In *Rhipsalis cassytha*, they are kidney-shaped and finely granular. In one section of *Mamillaria* (*Eumamillaria*) they are glossy and marked with sunken rounded pits (fig. 9^e); in another section (*Coryphantha*) they are frequently smooth; while in *Ariocarpus*, which is quite close to *Mamillaria*, they are comparatively large and tuberculate. In the little *Pelecyphora aselliformis* they are kidney-shaped, while in *P. pectinata* they have a peculiar boat-like form with a very large umbilicus. The seeds of nearly all *Pachycerei* (cardones) are used by the Indians for food. The "higos de tetetzo" of southern Puebla (*Pachycereus columna-trajani*) are a regular food staple and are to be found in the markets of Tehuacan in the month of May.

CLASSIFICATION.

Beginning with *Pereskia*, which most nearly resembles other dicotyledonous plants, and which in all probability approaches the ancestral type of the family, Schumann divides the Cactaceæ into three subfamilies: (I) *Pereskioideæ*, consisting of the single genus *Pereskia*; (II) *Opuntioideæ*, composed of *Opuntia* and its allies; and (III)

Cereoideæ, divided into two tribes, (1) *Echinocactææ*, including *Cereus* and its allies, *Echinocactus*, *Leuchtenbergia*, *Melocactus*, *Phyllocactus*, *Epiphyllum*, *Hariota*, and *Rhipsalis*; and (2) *Mamillariææ*, including *Mamillaria*, *Pelecyphora*, and *Ariocarpus*.

With a few exceptions the genera and subgenera of Cactaceæ, as treated by early writers, are not sharply separated by definite limits. In many of them there are transition species which have characteristics of two genera or subgenera. Thus there are species of *Echinocactus* very closely resembling certain *Mamillarias* (*Coryphanthæ*) in their structure, and the relationship of several of the columnar *Cerei* is not clear. Various authorities have divided the old genera of *Opuntia*, *Cereus*, *Echinocactus*, and *Mamillaria* into groups, sometimes regarding them as distinct genera, sometimes as subgenera, or "series." Many of these closely allied groups differ radically from

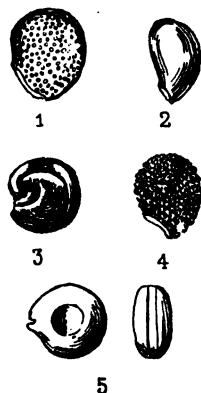


FIG. 9.—Cactus seeds.

one another, as in the structure of the seeds, yet in some cases there seem to be intermediate forms, and the flowers themselves are remarkably similar. Notwithstanding this, it would be of great assistance to the student of Cactaceæ to recognize many of the so-called subgenera as *genera*, not only for convenience of study, but also to show the systematic connection between the members of each group. In assigning the various species to a particular genus it will often be difficult to decide to which of two it belongs, but as Schumann says, this difficulty can not be avoided unless all the Cactaceæ be combined into a single genus *Cactus*.^a

In the following synopsis of Mexican genera, while following Schumann's arrangement I shall include various genera of Opuntioideæ and Cereoideæ established by Britton and Rose, including *Pereskioopsis* and *Carnegiea*, and the classification of *Cereus* and its allies published by Mr. Alwin Berger in the Sixteenth Report of the Missouri Botanical Garden, 1905, and by Britton and Rose in the Contributions from the United States National Herbarium, volume 12, pages 413 to 437, 1909. I have also consulted Labouret's *Monographie des Cactées* (Paris, 1858); Engelmann's Cactaceæ of the Mexican Boundary, with its beautiful plates by Paulus Roetter (Washington, 1859); Lemaire's delightful little handbook, *Les Cactées* (Paris, 1868); Förster's *Handbuch der Cacteenkunde*, second edition (Leipsic, 1886); Coulter's *Botany of Western Texas* (Washington, 1891-1894) and his revision of the North American Cactaceæ in volume 3 of the Contributions from the United States National Herbarium (Washington, 1894-1896); Schumann's *Gesammtbeschreibung der Kakteen* (Neudamm, 1899); and various numbers of the *Monatsschrift für Kakteenkunde*. The plates are reproductions of photographs by Mr. Guy N. Collins, Mr. C. B. Doyle, and Mr. E. L. Crandall, of the United States Department of Agriculture, Mr. T. W. Smillie, of the United States National Museum, and myself. The text-figures were drawn by Mr. Theodor Bolton, principally from photographs, and from the plates of Paulus Roetter already referred to.

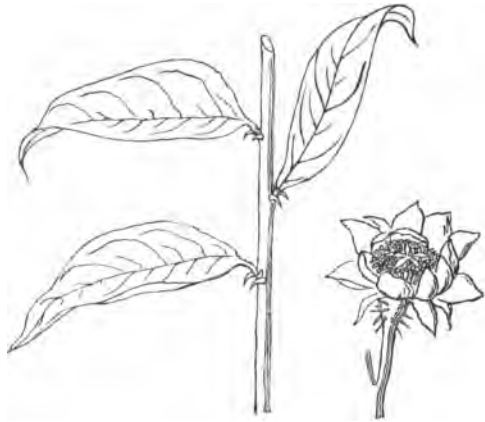
SYNOPSIS OF MEXICAN CACTACEÆ.

I. SUBFAMILY PERESKIOIDEÆ.

The best known representative of this subfamily, which consists of the single genus *Pereskia*, is the Barbados gooseberry *Pereskia aculeata*, a scrambling shrub with long, slender branches armed with recurved prickles, and glossy green leaves, like those of a lemon. The flowers grow in clusters and are peduncled, unlike those of all

^a Schumann, Karl. *Keys of the Monograph of Cactaceæ*, p. 6. 1903.

other genera of Cactaceæ, in which they are sessile and solitary. The petals are pale yellow or tinged with pink, the stamens yellow, and the 5-rayed stigma white. The bracted apple-shaped fruit, as I have already stated, is used in the West Indies for tarts and sauces, like gooseberries. *Pereskia tampicana*, a species closely allied to *Pereskia grandifolia* of Brazil, is a Mexican species, which has only been collected on the banks of the Rio Panuco, not far from Tampico, in the northern corner of Veracruz. Another species growing at Salinas Bay, on the west coast of Costa

FIG. 10.—*Pereskia aculeata*.

Rica, *Pereskia lychnidiflora*, attains the size of a small tree, and has yellowish-red flowers with petals fringed along the margin as in the genus *Lychnis*. Other arboreal species occur in tropical America. One of them, with long slender spines and the habit of an Osage

FIG. 11.—*Pereskia lychnidiflora*.

orange, was observed by the writer in 1896 growing in hedges at Punta Arenas, Costa Rica, where it was called *puipute*, or *matéare*. It has since been described by Weber as *Pereskia nicoyana*. Associated with it was a columnar organo (*Cereus aragoni* Weber) with edible fruit locally known as *tunas de organo*. *Pereskia autumnalis* (plate 10, fig. 1), called *manzanote* in Guatemala, was collected by O. F. Cook, of

the United States Department of Agriculture, in 1902, at El Rancho, near Zacapa, Guatemala. Excellent photographs of this species by Guy N. Collins have recently been published by Rose, in Contributions from the National Herbarium, volume 12, pages 399, plates 52,

53, 54, 1909. According to Professor Pittier the fruit is eaten by cattle during the dry season. The lens-shaped seeds have a glossy testa, which serves to distinguish this genus from the somewhat similar *Pereskopsis*, in which the seeds are covered with matted hairs.

II. SUBFAMILY OPUNTIOIDEÆ.

This subfamily is distinguished by the leaf-like cotyledons of its seeds; its fleshy leaves, either broad and lasting, as in *Pereskopsis* (pl. 10, fig. 2), or small, terete, and caducous, as in *Opuntia* and *Nopalea*; and by the barbed bristles, or glochidia, borne on the areoles, usually small and very numerous and mixed with soft wool. These glochidia are extremely sharp and barbed. They are loosely attached at their insertion, so that they are loosened by the slightest touch and adhere most annoyingly to the skin or clothing. In this subfamily the spine-bearing and the flower-bearing areoles are united into one circular pulvillus in the axil of the leaf. The spines occur in the lower and the bristles in the upper part of the pulvillus. Between the glochidia and surrounded by them, and always above the spines, the young shoot or flower originates (pl. 10, fig. 6). These glochidia correspond with the bristles and wool in the axils of some *Eumamillaria* and with the tomentum of the floriferous areole in *Coryphantha* and *Echinocactus*; but they are quite distinct morphologically from the spines themselves. They continue to grow year after year, becoming longer and more numerous, and in many species the spines themselves continue to grow and increase in number.^a

1. *Pereskopsis*.—This genus, with broad, fleshy leaves, needle-like spines, glochidia, opuntia-like fruit, and seeds covered with matted hairs, is represented in Mexico by several species. In the vicinity of Guadalajara the fruit of *Pereskopsis aquosa* (pl. 10, fig. 2) is gathered for food and sold in the markets as "tunas de agua." It has subspatulate-elliptical, sessile, acuminate leaves, which are obscurely 5-nerved. The areoles, which are scantily provided with wool, bear at length usually a single white or grayish spine tipped with brown. The edible part of the fruit is the watery endocarp, or rind, which has an agreeable odor and taste, somewhat like that of an apple. The seeds are margined distinctly, with the margin prolonged into a kind of tail-like process extending over the funiculus, or seed stalk, and are clothed with cotton-like fiber. Consequently they are quite different from the smooth, glossy, lens-shaped seeds of *Pereskia*, and would alone serve to distinguish *Pereskopsis* from that genus. Another species from the same locality is *Pereskopsis calandriniaefolia*, with broad, spatulate leaves and prominent cushions of felt on the areoles, from which several long, slender,

^a Engelmann, *Cactaceæ of the Mexican Boundary*, p. 45. 1859.



FIG. 1.—*Pereskia autumnalis*.



FIG. 2.—*Peresklopsis aquosa*.



FIG. 3.—*Opuntia arizonica*.

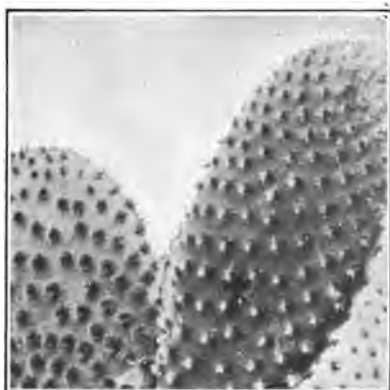


FIG. 4.—*Opuntia microdasys*.



FIG. 5.—*Opuntia tunicata*.



FIG. 6.—*Opuntia arizonica*.

LEAVES AND SPINES OF CACTACEÆ.



needle-like brown spines protrude. This species is locally known as "alfilerillo," or "tasajillo," from its resemblance when leafless to the true tasajillo (*Opuntia leptocaulis*). Other species are the slender-stemmed *Peresklopsis spathulata*, *P. pititache* of Tehuantepec, the very similar *P. brandegeei* of Lower California, *P. chapistle* of Oaxaca, and *P. porteri*, the "yellow rose" of Sinaloa.

2. *Opuntia*.—Formerly this genus was divided into two sections; Platopuntia, including plants with flattened joints; and Cylindropuntia, with joints cylindrical or terete. Various other classifications have been proposed, the latest and most satisfactory of which is that of Britton and Rose,^a who divide the genus into a number of groups which they call "series." Among those occurring in Mexico are the following:

Clavatæ, in which the joints are cylindrical or clubshaped and the spines unsheathed. Examples: *Opuntia bulbispina*, a prostrate species with spines bulbous at the base, often forming thickets in the State of Coahuila, north of Parras; *Opuntia emoryi* of Chihuahua and Sonora; and *Opuntia bradtiana* (*Cereus bradtianus* Coult.), a cereus-like erect species growing in Coahuila.

Cylindræ, with comparatively stout joints, and spines sheathed in scabbards, including the coyonostlis, or cardenches, *Opuntia imbricata* and *O. arborescens*, and the clavellinas, or abrojos, *Opuntia tunicata* (pl. 10, fig. 5).

Monacanthæ, also with sheathed spines but with slender-branched stems and a bushy habit of growth; including the tasajillos of northern and central Mexico *Opuntia leptocaulis* (fig. 12), with scarlet or coral-red fruit, and *O. kleinia*, with somewhat stouter stems and yellowish fruit. An interesting feature of these plants is that the fruit is often proliferous; that is, branches and flowers frequently grow from the areoles of the cuticle covering the fruit itself.

Pubescentes, with pubescent joints and sometimes without spines, though usually rich in bristles; including *Opuntia rufiga* and *O. microdasys* (pl. 10, fig. 4), usually called "nopalillos cegadores,"



FIG. 12.—Tasajillo (*Opuntia leptocaulis*.)

^a Britton and Rose. A preliminary treatment of the Opuntioideæ of North America. Smithsonian Misc. Coll., vol. 50, p. 503. 1908.

and *O. durangensis* and *O. leucotricha*, which bear the tunas duraznillos of Durango and central Mexico.

Criniferæ, with long wool growing from its areoles, including the nopal crinado of the State of Puebla (*Opuntia pilifera*).

Vulgares, prostrate plants unarmed or with a few spines, including our own little prickly pear of the eastern United States (*Opuntia opuntia*).

Subinermes, upright plants scarcely armed at all or even spineless, including the nopal de tuna Castilla (*Opuntia ficus-indica*), now so widely spread about the Mediterranean and in tropical America; the various varieties known as "tunas mansas" ("tame prickly pears") in Mexico; and the tuna camuesa (*O. larreyi*), cultivated about Queretaro.

Setispinæ, low plants with small joints and fine bristle-like spines, including *Opuntia filipendula* and *O. setispina* of Texas and Chihuahua.

Tunæ, bushy plants, often with abundant yellow spines, including the common prickly pear of Texas and Tamaulipas (*O. lindheimeri*), the cuija (*O. cuija*) of northern and central Mexico, and *O. tuna* of the West Indies and gardens of Mexico, with edible red fruit and yellow or red flowers.

Fulvispinosæ, bushy or spreading plants with brown or partly brown spines and fleshy fruits, including nopal de raiz of the Alvarez Mountains (*O. megarrhiza*), *O. engelmanni* of northern Mexico and Texas, and *O. arizonica* (pl. 10, figs. 3 and 6).

Albispinosæ, robust plants with white spines and broad petals, including the tuna cardona (*Opuntia streptacantha*) of San Luis Potosi, from which such enormous quantities of "tuna cheese" are made.

Stenopetalæ, large white-spined plants with narrow petals, including *Opuntia stenopetala*, which was first collected on the battlefield of Buena Vista, south of Saltillo, Coahuila.

The flowers of *Opuntia* (pl. 10, fig. 3) are for the most part yellow or orange, but in some species they are rose colored or crimson. One of the loveliest is the rose-colored flower of *Opuntia basilaris* of the southwestern United States. In all cases the perianth opens widely and the stamens are not so long as the petals. These features serve to distinguish the *Opuntia* from the closely allied genus *Nopalea*. The fruit ("tuna") of many species and varieties of *Opuntia* (pl. 9, fig. 6) is edible and is an important food staple.^a The young, tender mucilaginous pads are cut into strips ("nopalillos") and cooked like string beans, and the pads ("pencas") are also extensively used as

^a See Griffiths, David, and Hare, R. F. The Tuna as food for man. U. S. Dept. Agr., Bur. Plant Industry Bul. 116. 1907.

food for cattle in arid regions. The rigid, sharp spines with which most species are armed (pl. 10, fig. 6) is a serious drawback in feeding them to cattle, but these are frequently removed by singeing the pads with a torch. Efforts have been made to propagate spineless forms, and these have in many cases been successful.^a

3. *Nopalea*.—This genus is closely allied to *Opuntia*, but it may easily be distinguished by its flowers, the perianth of which is erect instead of widely spreading, and the stamens are longer than the petals, though they are exceeded by the style. The most important species of this genus is *Nopalea coccinellifera*, the “nocheznopalli” on which the cochineal insect is reared. The flower is of a beautiful rose color or crimson. The fruit is edible, but is inferior to most of the *Opuntia* fruits sold in the

Mexican markets. The plants are usually more or less tree like, growing to a height of 3 or 4 meters, with the trunk and older branches cylindrical or nearly so. The younger parts are flat and green, the joints oblong or ovate and compressed, usually spineless when young, and bearing small, fleshy caducous leaves like those of *Opuntia*, but sometimes becoming spiny when older. This plant was extensively cultivated by

the Mexicans before the discovery of America, for the sake of the dye-yielding insect which feeds upon it. Its cultivation was afterwards introduced into Guatemala, Honduras, the Canary Islands, Algeria, Java, and Australia. In recent years cochineal has largely been supplanted by aniline dyes, and its cultivation has been discontinued in nearly every place but the Canary Islands. The principal sources of its supply were formerly the states of Guerrero and Oaxaca. Other species of the genus growing in Mexico are *Nopalea dejecta* (called nopal chamacuerdo, at Victoria, Tamaulipas), which has narrowly oblong joints armed with whitish spines, and *N. karwinskiana*, which grows in the vicinity of Colima, on the Pacific coast. It is probably this species which grows about Guadalajara,



FIG. 13.—*Opuntia* flower, vertical section.



FIG. 14.—*Nopalea* flower.

^a See Griffiths, David. The Prickly Pear as a farm crop. U. S. Dept. Agr., Bur. Plant Industry Bull. 124. 1908.

in the State of Jalisco, where it is called "nopalillo de flor." A new species (*N. guatemalensis*) with linear reflexed leaves and very spiny areoles was recently described by Doctor Rose from specimens collected in Guatemala by Mr. William R. Maxon, of the United States National Museum. According to Professor Pittier, who obtained flowers and spines of this species at Zacapa, it is locally known as tuna lengua-de-vaca, or "cow's-tongue prickly pear." Figure 14, page 449, was made from Professor Pittier's photograph.^a

III. SUBFAMILY CEREIOIDEÆ.

In this group there are no glochidia, the spines are never barbed, and the leaves are reduced to scales often so minute as to be invisible to the naked eye. The ovules are not covered by the expanded funiculi; the seeds, instead of being bony and ivory colored, as in the Opuntioideæ, have dark, thin, glossy shells, either quite smooth, or pitted, or covered with wartlike tubercles; and the cotyledons, instead of being leaflike, as in the Opuntioideæ, are more or less globose.

Schumann divides this subfamily into two tribes: (1) *Echinocactæ*, including *Cereus* and its allies, *Echinopsis*, *Echinocactus*, *Leuchtenbergia*, and *Melocactus*, forming the subtribe *Armataæ*, which is characterized in general by stout, spiny stems; and *Phyllocactus*, *Epiphyllum*, *Hariota*, and *Rhipsalis*, forming the subtribe *Inarmataæ*, with spineless and leaflike or slender cordlike stems; and (2) • *Mamillariæ*, including *Mamillaria* and its allies, *Pelecyphora* and *Ariocarpus*.

In most of the *Echinocactæ* the flowers are tubular and the ovary and fruit either scaly or covered with little tufts of wool from which spines issue. In *Rhipsalis*, however, the flowers are wheel shaped. The fruits of some species of the *Cereus* group are unarmed, while in *Cactus* (*Melocactus*) the smooth, red, club-shaped fruit resembles the "chilitos" of a *Mamillaria*. Areoles, or pulvilli, as they are sometimes called, are composed of two parts, aculeiferous, or spine bearing, and floriferous, or flower bearing. In *Echinocactus* these are either united into a single areole or are separated by a short groove (as in *Echinocactus scheerii*). In *Echinocereus* the flower or young bud bursts through the epidermis above and close to the spiniferous areole. On the other hand, in some divisions of *Mamillaria* the spine-bearing and flower-bearing areoles are quite separate, the flowers appearing to spring from between the tubercles of the plant (pl. 9, fig. 1), while in the subgenus (or genus *Coryphantha*) the two areoles are joined by a long groove, and the flowers, growing from the nascent or very young tubercles, appear to spring from the apex of the plant (pl. 14, fig. 3) very much as in the group of the

^a See Rose, J. N. *Nopalea guatemalensis*, a new cactus from Guatemala. In Smithsonian Misc. Collections, vol. 50, p. 330. 1907.

tubercled Echinocacti to which *E. hexaedrophorus* (pl. 13, fig. 3) and *E. scheerii* (pl. 3, fig. 3) belong.^a

Tribe Echinocactæ.

1. *Cereus and its allies*.—The plants which have been grouped together under this name vary considerably in the characters of their flowers and fruit. They naturally form several distinct divisions which have been regarded by various authors as subgenera, or, in a few cases, as genera. Among the most recent authorities to treat of the group are Britton and Rose, who have established a number of new genera and have raised the giant sahuaro, or suguaro, of our southwestern deserts into a monotypic genus, named *Carnegiea*,^b after Mr. Andrew Carnegie, to whose generosity the Desert Laboratory of the Carnegie Institution owes its existence.^c The most important studies of the genus thus far have been those of Mr. Alwin Berger, published in the Sixteenth Report of the Missouri Botanical Garden, 1905, and Britton and Rose in volume 12 of Contributions from the National Herbarium, pages 413 to 437, 1909. From the classification of Berger and from Britton and Rose I take the following list of genera:

Cereus, as understood by Britton and Rose, includes *Cereus hexagonus* (usually called *C. peruvianus*) and *C. jamacaru*, night-flowering cacti with columnar upright, branching, ribbed, fluted, or angled stems and branches, and beautiful white flowers with numerous stamens and many-rayed stigma. Though of South American origin these species are now widely spread in the West Indies, the first also in Central America and tropical Mexico.

Rathbunia, named by Britton and Rose in honor of Dr. Richard Rathbun, Assistant Secretary of the Smithsonian Institution in charge of the U. S. National Museum, includes several species indigenous to the coast of Western Mexico, among them *Rathbunia alamosensis* (*Cereus alamosensis* Coulter), a plant with sharp irregular ribs, brown velvety areoles, stout spines, and bright salmon-colored trumpet-shaped day-blooming flowers, first collected by Doctor Palmer, near Alamos, southern Sonora.

Nyctocereus, the type of which, *Nyctocereus serpentinus*, called junco espinoso in the State of Jalisco, is often seen in collections. This species has straggling cylindrical fluted stems and branches with numerous areoles bearing a tuft of white wool and weak radiating

^a Engelmann, George. Cactaceæ of the Mexican Boundary, p. 46. 1859.

^b Britton, N. L., and Rose, J. N. A New Genus of Cactaceæ. Journ. New York Bot. Garden, vol. 9, p. 185. 1908.

^c See Coville, Frederick V., and MacDougal, D. T., "Desert Botanical Laboratory of the Carnegie Institution," Publication No. 6 of the Carnegie Institution of Washington.

bristle-like spines. The large white flowers are night blooming, and the fruit contains a few large seeds imbedded in red pulp.

Cephalocereus, in which the flower-bearing portion is differentiated from the rest in the form of a woolly head, or cephalium, near the apex of the stem, either symmetrical and terminal or one-sided. The fruit (fig. 16), covered with a bare skin becomes shriveled with age. Examples: *Cephalocereus senilis*, the cabeza de viejo, or old man's head, of the limestone cliffs of Hidalgo, Guanajuato, and Puebla; *C. cometes*, of San Luis Potosi; and *C. palmeri* ("organo"), of Victoria, Tamaulipas.



FIG. 15.—*Cephalocereus senilis*.

Lophocereus, in which the stem and branches are ribbed very much as in *Myrtillocactus*, and the areoles are remote on the sterile portions but crowded on the flower-bearing branches, and on the latter produce short white wool and long stiff bristles. Example: *Lophocereus schottii*, the sina or sinita (old-man cactus) of Sonora and Lower California.

Myrtillocactus, which may be recognized by its short trunk, bluish-green branches curving upward, with six ribs, which form a starlike cross section and are armed with stout dagger-like spines, usually with a stout laterally compressed central and 5 radials about its base. Example: *Myrtillocactus geometrizans* (pl. 11, fig. 1) which yields the small fruit called "garambullas."

Pachycereus includes several giant cardones of the Pacific coast region, among them *P. pringlei* and *P. pecten-aboriginum*. The first of these may be recognized by the little spheres of yellowish tomentum with which its fruit is covered (fig. 17); the second by its spiny fruit, resembling great chestnut burs, which the Indians use for hairbrushes. The seeds of these species are parched, ground, and used for food. The common organo of central Mexico, is placed in this genus by Britton and Rose, under the name *Pachycereus marginatus* (*Cereus gemmatus* Zucc.). This species is much used for hedges (pl. 11, fig. 2). Its fruit is not edible and the areoles are so close together as to form almost a continuous line along the ribs. The spines are short and inconspicuous and often become obsolete on old plants. Another species belonging here is the tetetzo of southern Puebla (*P. columna-trajani*).



FIG. 16.—*Cephalocereus* fruit.

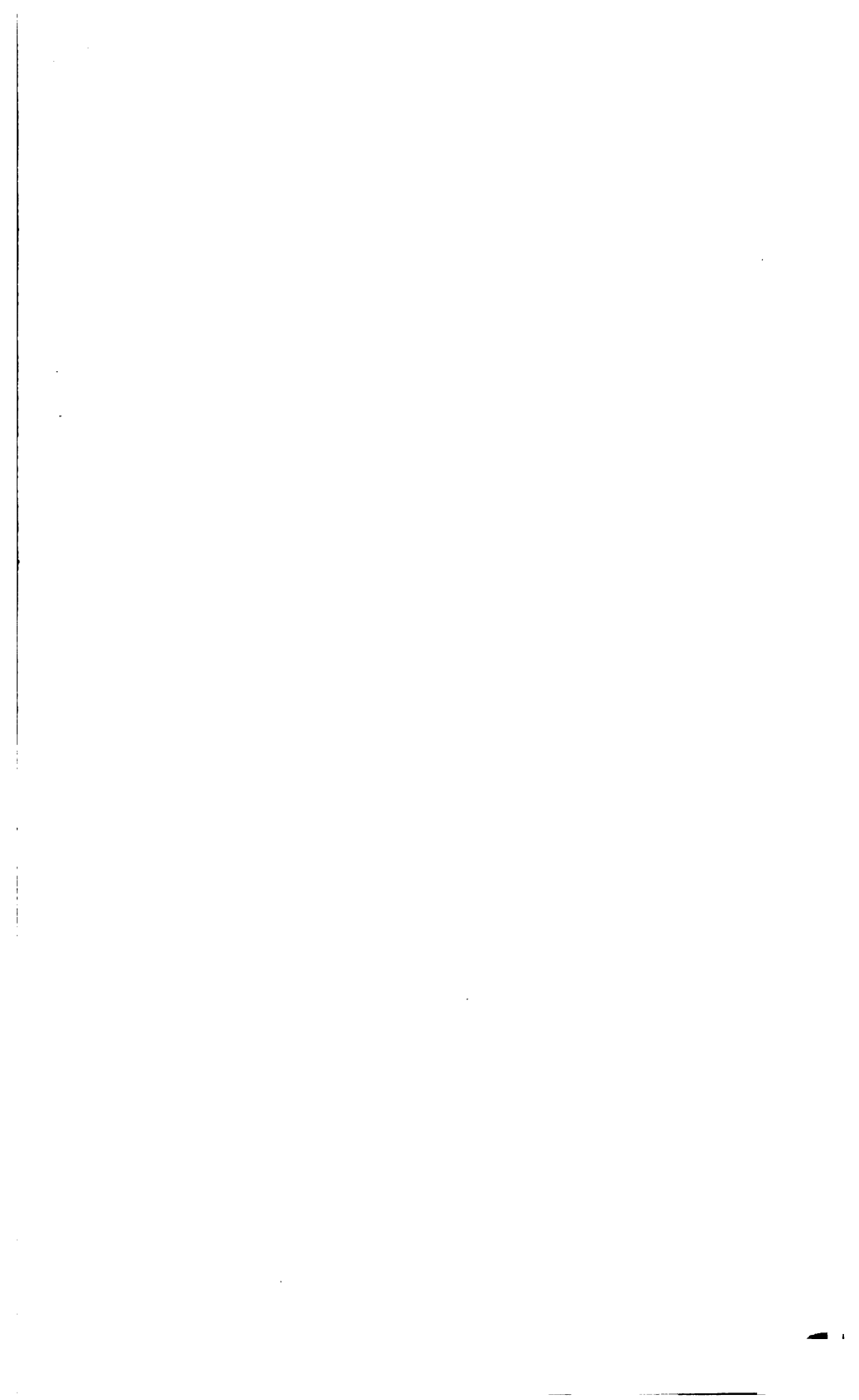




FIG. 1.—*Myrtillocactus geometrizans*.



FIG. 2.—*Pachycereus marginatus*.

ARBOREOUS CACTACEÆ OF GUANAJUATO.

Escontria includes a single species, the chiotilla, or xiotilla, of southern Puebla and Oaxaca (*Cereus chiotilla* Weber).

Carnegiea includes the giant sahuaro, or suguaro (*Cereus giganteus*), already referred to, the fruit of which, called "pitahaya," is an important food staple of the Indians, but is not so highly esteemed as the pitahaya dulce of *Lemaireocereus thurberi*.

Lemaireocereus, as proposed by Britton and Rose, includes plants of widely different habits. Under this genus are placed the pitahaya agria (*Cereus gummosus* Engelm.) and the chirinole, or chilénola, of Lower California (*Cereus eruca* Brandeg.), both of them prostrate plants with scarlet pitahayas containing pleasantly acid pulp; the columnar pitahaya dulce of Sonora and Lower California (*Cereus thurberi* Engelm.); and the pitahaya of Mexico and Central America, *Cereus griseus* Haw. (*C. eburneus* Salm-Dyck), figured by Rose in vol. 12 of the Contributions from the National Herbarium, pl. 67, from a photograph taken by G. N. Collins at El Rancho, near Zacapa, Guatemala. Another species assigned to the genus is *Cereus weberi* Coulter (*Cereus candelabrum* Weber), the massive organo so characteristic of the scenery about Tomellin, on the way from Tehuacan to Oaxaca, with its numerous thick crowded vertical branches rising from a short central trunk.

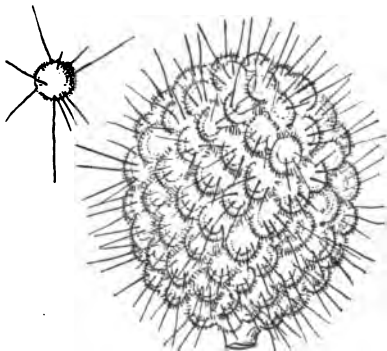


FIG. 17.—*Pachycereus pringlei*, fruit.

Peniocereus, with the single species *Peniocereus greggii* (*Cereus greggii* Engelm.) is remarkable for the enormous fleshy root, from which the slender 4-ribbed or 5-ribbed stem rises. The large white nocturnal flowers are remarkable for their very long slender tube, bearing small clusters of spines on its outer surface. The ovoid, long-acuminate scarlet fruit, bearing elevated spineless areoles, is edible. Excellent figures of this plant are published by Rose (l. c., p. 428, plates 74 and 75) from photographs taken by Francis E. Lloyd near Tucson. The range of the species extends to northern Mexico, Texas, and Arizona.

Hylocereus includes the well-known *Cereus triangularis* and *Cereus trigonus*, as well as *C. ocamponis* and *C. napoleonis*. There is much confusion between the first two mentioned, but *Hylocereus trigonus* (pl. 12), founded by Haworth on Plumier's plate 200, figure 2, published in 1755, may be recognized by the salient points of its angular

ribs, which bear the areoles, while in *H. triangularis* the areoles are borne in the notches of the crenations of its compressed wing-like ribs.

Selinocereus, with large white fragrant night-blooming flowers, includes the queen-of-the-night cactus (*Cereus grandiflorus*), known in Tamaulipas, Mexico, as organillo; the common "night-blooming cereus" of our conservatories, *Cereus pteranthus* (*C. nycticalus* Link), and *Cereus hamatus*, with remote hook-like processes along the ribs.

Acanthocereus, as treated by Schumann, has a single species which has received various names: *Cereus princeps* Pfeiff., *Cereus variabilis* Engelm. (not Pfeiff.), and *Cereus baxaniensis* Karw. It has now been identified as Linnaeus's *Cactus pentagonus*, and should therefore be called *Acanthocereus pentagonus* Britt. and Rose. It is a night-flowering cactus with erect or reclining 3 to 6 angled stems, the areoles distant, bearing 4 to 6 stout, radiating, unequal spines. The flowers have long tubes, green sepals and white petals; the oval spiny fruit (pitahaya) is bright scarlet with thick black seeds and luscious red pulp. This species occurs on both sides of the Rio Grande and extends southward along the Mexican coast into Central America. It also occurs in the West Indies.

Heliocereus, with crimson or purple-red flowers, includes the well-known *Cereus speciosus* of conservatories and the very closely allied *C. coccineus* and *C. schrankii*. In the state of Jalisco *H. speciosus* is sometimes called Santa Maria, or xoalácatl. It has large purple-red flowers with an iridescent bluish center, which remain open for several days. The 3 to 5 ribs are serrated, the areoles occupying the short upper side of the serrations, bear white wool and clusters of 5 to 8 stiff, slender, sharp-pointed spines, the under one yellow and bristle-like.

Wilcoxia includes two slender-stemmed species with large fleshy roots: *Cereus poselgeri* (*Cereus tuberosus* Poselg.), called sacasil in Nuevo Leon, with stems as thick as a lead pencil, purple flowers, and woolly fruit bearing black and white bristles; and *Cereus striatus*, with stems no thicker than straws, soft harmless spines, purple flowers, and scarlet spiny fruit. The latter species was collected by Dr. Edward Palmer on Carmen Island, Gulf of California. It occurs on the peninsula of Lower California and in Sonora, where its common name is sacramatraca, saramatraca, or pitayita. It is identical with the plant described by Weber as *Cereus diguetii*.

Aporocactus includes the slender stemmed rat-tail cactus, *Cereus flagelliformis* (fig. 18), with beautiful rose-colored or crimson zygomorphic flowers, which are sold in the drug markets of Mexico under the name of flor de cuerno, for use as medicine.

Echinocereus is characterized by diurnal flowers, comparatively short and rarely tubular. The ovary and tube bear prickly and woolly

areoles; the floral leaves are usually showy and more or less spreading, the stamens numerous and inserted along the tube, the style longer and ending in the several-rayed green stigma (fig. 19). Schumann recognizes several subsections; among them, Subinermes (including *E. pulchellus* and *E. subinermis*), Prostrati (including *E. scheeri*, *E. berlandieri*, *E. procumbens*, *E. cinerascens*, *E. enneacanthus*, *E. leonensis*), Erecti pectinati (including the pectinately spined *E. ctenoides*, *E. chloranthus*, *E. longisetus*, *E. pectinatus*, *E. cæspitosus*, *E. roetteri*), Erecti decalophi (including the needle-spined *E. acifer*, *E. conglomeratus*, *E. dubius*, *E. merkeri*, *E. stramineus*). Among the plants mentioned above *E. cinerascens*, with decumbent clustered stems, yields an edible spiny fruit with the flavor of a raspberry; several of the pectinate spined forms have zones of red and white or yellowish, owing to the color of the spines, and are known as "rainbow cacti;" and *E. stramineus* and its close allies are known as strawberry cacti, from the edible fruit they bear.



FIG. 18.—*Aporocactus flagelliformis*.

Cereus fruits.—The fruits of many species of *Cereus* and allied genera are juicy, fine flavored; and nutritious. Their general name throughout Mexico is pitahaya, a word of Carib, or Haytian, origin,

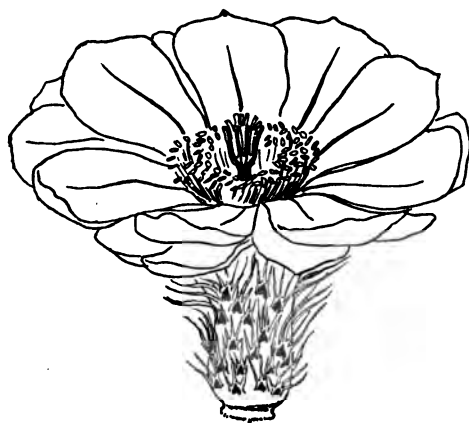


FIG. 19.—*Echinocereus* flower.

early brought to Mexico by the Spanish conquistadores, and sometimes modified to pitaya, or to its diminutive form pitayita. The following description of a pitahaya was given as early as 1535, by Oviedo:

Pitahaya is a fruit of the size of a closed fist, more or less, and this is the common size. It is borne on certain very spiny and strange-looking thistles, which are leafless but have a few branches or long arms which take the place of

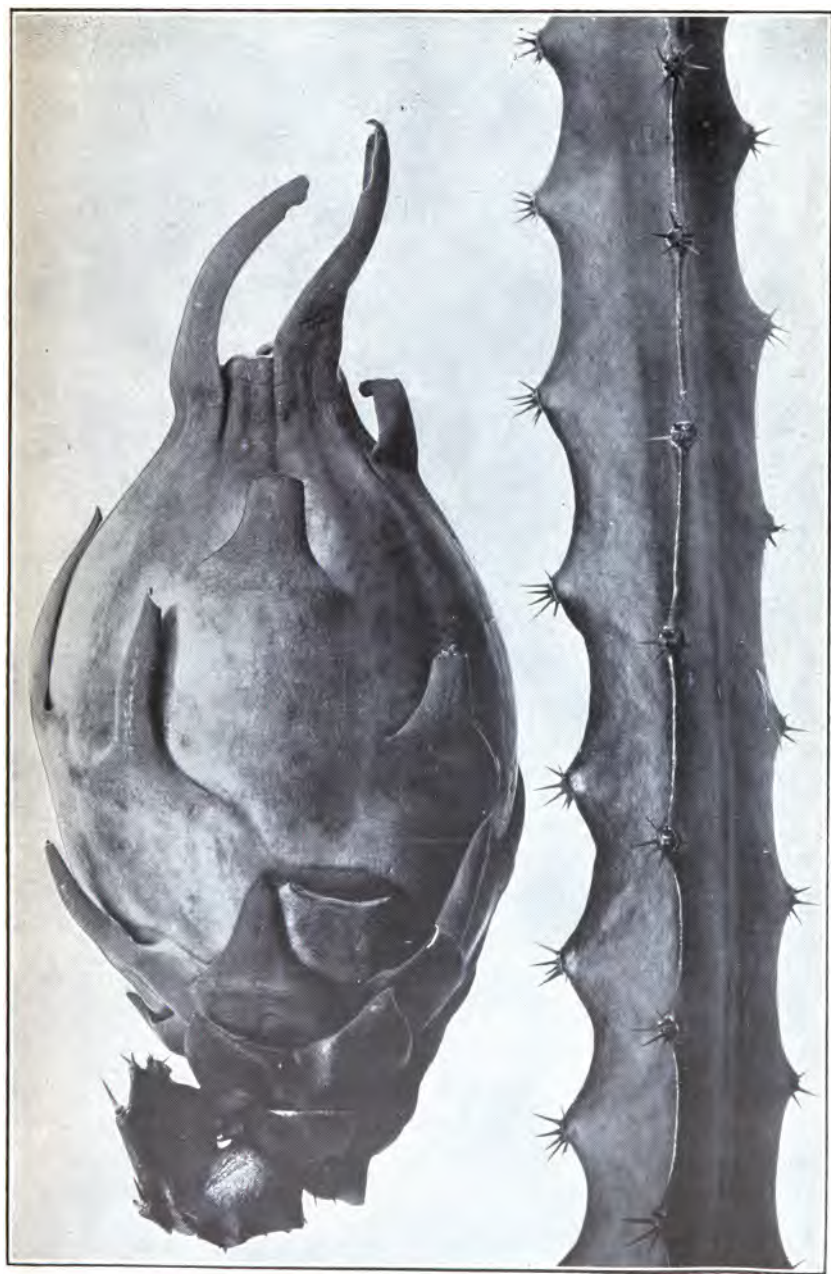
branches and leaves. These are four angled and longer, each branch or arm, than the arm length of a man; and between angle and angle a groove, and on all these angles and grooves at intervals are borne certain sharp and pointed spines as long as half the middle finger of the hand or more, arranged three by three or four by four; and among these leaves or branches, such as I have

described is borne this fruit called "pitahaya," which is very red, like rosy crimson, and the name signifies "scales on the rind," though they are not such; and it has a thick skin, and this when cut with a knife (which is done easily) is full of little seeds within, like a fig; but they are mixed with a paste or pulp which, together with the seeds, is of a fine crimson color; and the whole mixture, seeds and all, is eaten, and whatever it touches remains as red as though touched by mulberries, and even more so. The fruit is wholesome and is relished by many, but I should prefer many others to it. It affects the urine the same as tunas, though not so quickly, but two hours after two or three of them are eaten the urine appears like blood itself. It is not a bad fruit nor harmful, and appears well to the sight. The thistles on which these pitahayas are borne are an obnoxious thing, and of much strangeness their forms, the which are green and the spines gray or whitish, and the fruit red, as I have said, and as I have drawn it (pl. 3, fig. 3). In removing a pitahaya from where it grows one must not be in a hurry, nor be without caution and a good knife, because those thistles are close together, crowded, and many, and very well armed. Other pitahayas there be, which differ neither more nor less from the ones I have described, together with their thistles, in any manner or in taste, but only in color; because these others are yellow and what is within them is white, which is eaten, and the little seeds are black, and they do not cause any change in the urine. I have made ink of the first kind and written with it, and it is of excellent color, between purple and bright crimson.^a

The identity of the plant described by Oviedo has not been established. It may possibly be the variable *Acanthocereus pentagonus*. The accompanying figure (pl. 12) is a photograph by Mr. G. N. Collins of a plant growing on the island of Porto Rico. It corresponds perfectly with Plumier's plate 200, figure 2, on which Haworth founded the species *Cereus trigonus*, and differs from Oviedo's plant in the shortness of the spines and in other respects. The branches of the species here figured are sometimes triangular and sometimes quadrangular. The fruit is rose-colored on the surface and it is filled with white, agreeable-tasting pulp surrounding the numerous small black seeds.^b *Hylocereus trigonus* is characterized by salient points on the ribs, which bear the areolæ. In *H. triangularis* the areolæ are situated in the notches of crenations. Closely allied to the latter species is a triangular cereus growing on the garden walls of the city of Guadalajara, recently described by M. Robert Roland Gosselin under the name *Cereus tricostatus* (pl. 6, fig. 1). This plant is characterized by its sharp, thin ribs, which are prominently gibbous between the areoles. The spines are quite small and few in number, sometimes only two, or even solitary. The fruit is sold in the market of Guadalajara, both fresh and dried, under the name pitahaya.

^a Oviedo. Hist. Gen. y Nat. de las Indias, lib. 8, Cap. 26, pl. 3, fig. 9. 1535. Ed. of José Amador de los Ríos, p. 311. 1851.

^b See Cook and Collins. The Economic Plants of Porto Rico. Contr. U. S. National Herbarium, vol. 7, p. 112, pl. 25. 1903.



HYLOCEREUS TRIGONUS (HAW.) N. COM.



FIG. 1.—*Echinocactus palmeri*.



FIG. 2.—*Echinocactus bicolor*.



FIG. 3.—*Echinocactus hexadrophorus*.

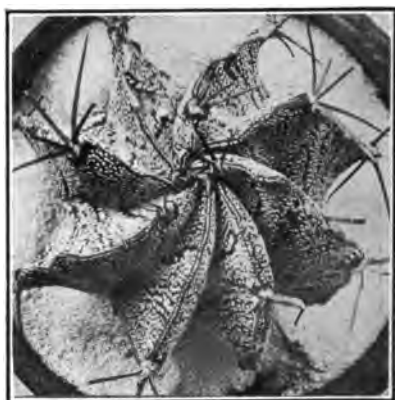


FIG. 4.—*E. (Astrophytum) ornatus*.



FIG. 5.—*Echinocactus pringlei*.



FIG. 6.—*Echinocactus cornigerus*.

The pitahayas of *Carnegiea gigantea* of Arizona and northern Sonora were noticed as early as 1540 by the members of Coronado's expedition. They are not spiny, like the fruits of *Pachycereus*, and they burst open when ripe. The pitahaya dulce (*Lemaireocereus thurberi*) is much sweeter and is covered with stout spines, which grow in clusters from little tufts of wool. Another columnar cactus with spiny pitahayas is *Cereus queretarensis* of southern Jalisco, Queretaro, and Guanaquato. The most important edible pitahaya of central and southern Mexico is *Lemaireocereus griseus* (pl. 9, fig. 5), a spherical fruit bearing tufts of spines and wool, somewhat resembling the pitahaya dulce of the west coast. *Myrtillocactus geometrizans* (pl. 9, fig. 2) bears the well-known little garambullas offered for sale in the market, either fresh or dried; and in northern and central Mexico several species of *Echinocereus*, locally known as strawberry cacti, or "alicoches," bear delicious spiny pitayitas (pl. 9, fig. 3) highly esteemed by the natives.

2. *Echinocactus* and its allies.—Under the genus *Echinocactus* Schumann includes several groups of cacti regarded by him as subgenera. Some of them are treated by other authors as distinct genera, although there occur forms which seem intermediate between two or more of the groups. Whether or not these groups be regarded as genera, there is no doubt that by separating them from one another and calling them by their distinctive names greater facility will be found in recognizing the distinguishing characteristics of the various species and their study will be much simplified.

They may be defined as fleshy plants, globular, oblong, or cylindrical in shape, with vertical or radiating ribs, or rows of vertical or spiral tubercles, which are usually armed by stout spines. The leaves are reduced to microscopic vestiges or are obsolete. The flowers spring from areoles very near those which subsequently produce the spines. The perianth tube is prolonged beyond the ovary, and is usually covered with scales, either naked or bearing tufts of wool

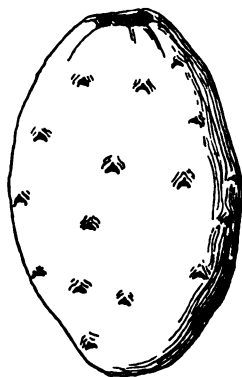


FIG. 20.—*Carnegiea gigantea*, fruit nearly ripe.



FIG. 21.—*Echinocactus*, flower.

in their axils. The outer floral leaves are scalelike, the inner elongated and sepal-like, and the innermost like true petals. The stamens are numerous and are borne on the tube of the perianth, and the style columnar and bearing a several-rayed stigma. The fruit is usually covered with scales, and often with tufts of minute bristles, in some species surrounded about its base by a thick growth of silky wool. Some of the plants belonging here are composed for the most part of succulent pulp, which is candied and made into preserve like citron. Others possess poisonous or narcotic alkaloids, and are used as intoxicants by the Indians. In a few the fruit is edible (pl. 9, fig. 4), and several yield an abundant supply of watery sap, which, though insipid, yields a grateful drink to the thirsty traveler.



FIG. 22.—*Echinocactus*, fruit.

The principal divisions of the Echinocacti, including Mexican species, are the following:

Cephalocactus, including the great viznagas, *Echinocactus palmeri* (pl. 8) and *E. wislizeni*, from which sweetmeats are made: *E. horizontalis* (pl. 2, fig. 5), *E. bicolor* (pl. 13, fig. 2), *E. pilosus*, and the closely allied crimson-spined *E. pringlei* (pl. 13, fig. 3).

Lophophora, represented by the single species *Lophophora williamsii*, the narcotic peyote, or mescal button of the Indians (pl. 3, fig. 5).

Astrophytum, or "starfish cactus," including the spineless "bishop's cap" (*Astrophytum myriostigma*), *A. capricornus* (pl. 5, fig. 2), and *A. ornatum* (pl. 13, fig. 4).

Euechinocactus, or *Echinocactus* proper, including *E. pottsii* and *E. electracanthus*.

Ancistrocactus, or hook-spined *Echinocactus*, divided into two sections, the first composed of species having wiry spines, bent like fishhooks, including *Echinocactus longihamatus* (pl. 9, fig. 4), the closely allied *E. uncinatus*, and *E. brevihamatus* (pl. 3, fig. 3); the second with dilated horn-like spines, often flattened on the upper side, annulated or transversely ribbed and curved near the tip, including *Echinocactus cornigerus* (pl. 13, fig. 6), *E. texensis* (pl. 2, fig. 1), *E. emoryi*,^a and *E. wislizeni* of Arizona.

Stenocactus, including *Echinocactus multicostatus* (pl. 4, fig. 3) and its allies (pl. 4, fig. 5), and *E. coptonogonus*.

^a For an illustration of an Indian drinking the sap of *Echinocactus emoryi*, see Coville, Frederick Vernon "Desert plants as a source of drinking water." Smithsonian Rep. for 1903, pp. 499-505. 1904.

Thelocactus, with the surface covered with tubercles more or less confluent, as in *Echinocactus lophothele* (pl. 3, fig. 1) and *E. rinconadensis*, or 5 or 6 sided, as in *E. hexaedrophorus* (pl. 13, fig. 5).

3. *Leuchtenbergia*.—This genus, which is represented by a single species, *L. principis*, stands quite alone among the Cactaceæ. It has a woody stem bearing long prismatic tubercles very much like those of certain *Mamillarias*, but the flower has a scaly tube more like that found in the genus *Echinocactus*. The tubercles are arranged spirally and are at length deciduous, their bases leaving the stem scarred very much like that of a *Zamia* after its leaves have fallen. The areoles, situated at the tips of the tubercles, are cottony or woolly when young and bear a tuft of flexible papery or strawlike spines. The large axillary brownish-yellow fragrant flowers appear from among the young tubercles near the crest of the plant. The stamens are numerous, the outer ones growing together and connate with the tube of the perianth, which they close, their upper parts free and closely fasciated around the style, which exceeds them slightly in length, bearing a 10-14-rayed bright yellow stigma. This species is used by the Mexicans as a remedy for certain diseases of animals, and at one time was gathered in such quantities as to threaten its extinction. It has been collected in the vicinity of Pachuca, Hidalgo; southeast of San Luis Potosi; and in the vicinity of Patagallina, southeast of Parras, Coahuila.



FIG. 23.—*Leuchtenbergia principis*.

4. *Cactus* (*Melocactus*).—The plants of this genus, often called turk's-cap or turk's-head, are fleshy and globose, or oval, usually ribbed like a melon and bearing tufts of rigid spines very much like those of an *Echinocactus*. It differs, however, from that genus in having a distinct cylindrical cap, or cephalium, composed of woolly felt and fine bristles, from which issue the numerous small inconspicuous flowers and at length the fruit. The latter is red, smooth, and club shaped, very closely resembling the chilitos of certain *Mamillarias*, and, like them, pleasantly acidulous and edible. The genus is principally West Indian and tropical American. A photograph of *Cactus maxonii* (*Melocactus maxonii* Gürke), showing a single fruit and several flowers, is reproduced on plate 2, figure 2.

5. *Phyllocactus*.—This genus is epiphytal. It has leaflike joints and beautiful, large, elongated flowers, which, unlike those of *Epiphyllum*, are perfectly regular and funnel shaped, with separate stamens growing from the tube and not connate at the base. The fruit is red, scaly, or marked with the scars left by deciduous scales. That of *Phyllocactus anguliger*, which grows on the slopes of the volcano of Colima, is called "pitayita del cerro," and is used in preparing a refreshing drink like lemonade. The flower of this species is tinted from flesh color to white. Another species with scarlet flowers (*Phyllocactus ackermanni*) is widely cultivated in Mexico.



FIG. 24.—*Phyllocactus phyllanthoides*.

6. *Epiphyllum*.—The flowers of this genus are distinctly irregular, or zygomorphic, and curved; stamens grouped in two series, the inner group of 10 stamens growing together at the base so as to form a tube. The stems are flat and jointed, the joints articulating somewhat like the segments of a crab's claws. The only well-defined species is the "crab cactus," *Epiphyllum truncatum*, from Brazil, widely cultivated in conservatories for its beautiful crimson flowers, which, instead of growing from the margin of the joints as in *Phyllocactus*, are terminal.

7. *Rhipsalis*.—Of this epiphytal genus, which is distinguished among all the Cactaceæ as the only one occurring spontaneously in the Old World, I have already spoken (see fig. 1, p. 537). In the island of Ceylon *Rhipsalis cassytha* is called "mistletoe" by the English residents, on account of its habit of growth and its small, pellucid, glutinous berries.

Tribe Mamillariæ.

8. *Mamillaria* and its allies.—The plants of this genus are usually spherical, hemispherical, or cylindrical in form and covered with wart-like or teatlike tubercles, usually arranged in regular spirals and

terminating in small spine-bearing areoles. The spines vary greatly in form, occurring in radiating starlike groups, with or without a central spine, pectinate or comblike, or long and wiry. In some species they are as fine as hairs, in others they are stout and clawlike; some are straight, others curved like fishhooks; some are smooth, others hairy, and others plumose or feathery. They are divided by Schumann into four groups: (1) *Coryphantha*, in which the flowers issue from near the center or apex of the plant and the tubercles have a longitudinal groove uniting the flower-bearing and spine-bearing areoles; (2) *Dolicothele*, in which the tubercles are long and ungrooved and the flowers issue from the axis of the tubercles; (3) *Cochemiea*, occurring on the peninsula of Lower California and in Chihuahua; and (4) *Eumamillaria*, or *Mamillaria* proper. These are usually regarded as subgenera, but they may be worthy of generic rank.

(1) *Coryphantha* is divided into two series: *Aulicothelæ*, in which the tubercles are without glands, as in *Mamillaria durangensis*, *M. macromeris*, *M. scheerii*, *M. elephantidens* (pl. 14, fig. 3), *M. conoidea* (pl. 14, fig. 1); and *Glanduliferæ*, in which circular red or yellow glands are present in the axils of the tubercles or under the areoles, including *Mamillaria macrothelæ* and *M. erecta*.

(2) *Dolicothele*, with comparatively large yellow flowers and bristlelike or needlelike spines radiating from the terminal areole of the long tubercle, is composed of the two species *Mamillaria spherica*, of Texas, and the closely allied *M. longimamma* of Mexico (pl. 14, fig. 2), both of which contain poisonous alkaloids.

(3) *Cochemiea*, characterized by large flowers with exserted stamens, is represented in northern Mexico by the single species *Mamillaria senilis*, with many white, bristle like radial spines and several dark-colored hooked central spines, and with large orange-colored flowers, occurs amid the snow of the high mountains of Chihuahua. *M. roseana* occurs at La Paz and on Carmen Island, where it was collected by Dr. Edward Palmer; and *M. pondii* on Cedros Island, where it was collected by Lieut. Charles F. Pond, U. S. Navy.

(4) *Eumamillaria*.—This division is composed of two groups, the first including plants with watery sap, called by Schumann "Hydrochylus," the second with plants containing milky or gummy latex, called "Galactochylus."

Among the species included in the section *Hydrochylus* are *Mamillaria micromeris*, *M. greggii* (pl. 4, fig. 1), *M. leona* (pl. 2, fig. 3), *M. candida*, *M. pusilla* (pl. 2, fig. 4), *M. bocasana* (pl. 4, fig. 4), *M. glochidata*, *M. plumosa* (pl. 3, fig. 6), and *M. grahamii*, *M. carretii* (pl. 4, fig. 2).

Among the species included in the section *Galactochylus* are *Mamillaria elegans*, *M. celsiana*, *M. heyderi* (pl. 9, fig. 1), *M. melanocentra*,

M. gigantea, *M. heesiana* (pl. 7), *M. centricirrha*, *M. meiacantha*, *M. uncinata*, *M. sempervivi*, *M. caput-medusæ*, *M. formosa*, *M. karwinskiana* (pl. 14, fig. 4), and *M. mutabilis*.

9. *Pelecyphora*.—Only two species of this interesting genus are thus far known. They are very small plants, globular, hemispherical, or club shaped in form, and covered with peculiar laterally compressed tubercles having a very long, narrow areola, bordered on each side by a row of short appressed comblike spines. *Pelecyphora aselliformis*, usually growing in clusters (pl. 14, fig. 6), derives its specific name from the resemblance of its tubercles to the ventral surface of certain isopods, or sow bugs (*Aselli*). Specimens were collected by Dr. Edward Palmer in May, 1905, at Zapotillo, 12 miles east of the city of San Luis Potosi, where the plants are sold in the drug market under the name of "peote," "peyote," or "peotillo." Another locality where they are found, and which takes its name from them, is the Hacienda de Peotillas, a station on the Central Railway, which connects San Luis Potosi with Tampico. One of the specimens collected by Doctor Palmer bloomed after it had been gathered. The flower is comparatively large and of a magenta or crimson-purple color, with the outer petals rose-colored and paler on the margin, and the outermost sepallike, narrowly linear and greenish white. The stamens are only about one-third the length of the petals; they have white filaments and orange-colored anthers, beyond which the pistil projects with its greenish-yellow 4-rayed stigma.

Pelecyphora pectinata (pl. 14, fig. 5), the other species, which is here figured for the first time, is a beautiful little plant represented in the cactus house of the United States Department of Agriculture by specimens collected by Dr. J. N. Rose in 1905, in the State of Puebla. It is smaller than *P. aselliformis*, spherical at first, but at length cylindrical. Unlike *P. aselliformis* it has milky juice and yellow flowers, and is solitary. Its minute white spines are pectinate, very much like those of certain species of *Echinocereus* and *Mamillaria*, and so closely crowded that they interlace. Plate 14, figure 5, shows a young plant of this species enlarged 6 diameters.

10. *Ariocarpus*.—This genus, called by Lemaire "*Anhalonium*," is composed of several species of low top-shaped plants with large taproots surmounted by a rosette of more or less leaflike tubercles. These are made up of two parts corresponding roughly to the blade and claw of certain petals. The lower portion, or claw, is flattened and appressed along the stem of the plant; the upper part, or blade, is turned outward and consists of a more or less pyramidal body, the upper face of which is somewhat triangular in outline. The entire surface of this blade is covered with a cartilaginous coat, which, together with the absence of spines, distinguishes this genus from the

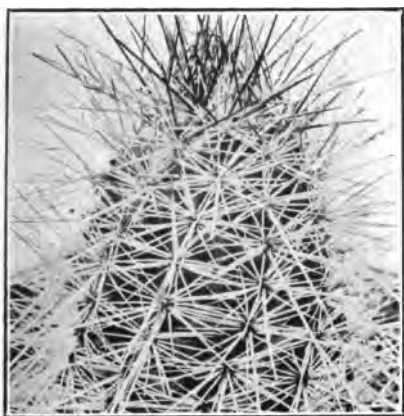


FIG. 1.—*Mamillaria conoidea*.



FIG. 2.—*Mamillaria longimamma*.



FIG. 3.—*M. (Coryphantha) elephantidens*.



FIG. 4.—*Mamillaria karwinskiana*.



FIG. 5.—*Pelecyphora pectinata*
(enlarged 6 diameters).



FIG. 6.—*Pelecyphora aselliformis*
(slightly reduced).



FIG. 1.—*Ariocarpus retusus*.



FIG. 2.—*Ariocarpus furfuraceus*.

ARIOCARPUS RETUSUS AND ARIOCARPUS FURFURACEUS.

closely allied *Mamillaria*.^a At the apex of the tubercles there is a more or less distinct wool-bearing areole. The flowers appear from near the center of the plant, springing from the midst of a tuft of wool. They are white or delicately rose tinted, with the petals marked by a median stripe. The ovary and fruit are naked, the seeds comparatively large and tuberculated.^b

Among the species thus far known to science are *Ariocarpus fissuratus*, sometimes called the "living rock," with the surface of the tubercles grooved and warty; *A. kotschubeyanus* (pl. 3, fig. 4), called *pezuña de venado*, with rose-colored flowers, and small delta-shaped tubercles marked by a median longitudinal groove; *A. retusus*, or "cobbler's thumb" (pl. 15, fig. 1), with sharp pyramidal tubercles (sometimes called *A. prismaticus*); and *A. furfuraceus* (pl. 15, fig. 2), with abruptly acuminate triangular tubercles, sold for medicinal purposes in Mexican markets under the name of "chautle." On plate 5, figure 1, is shown the photograph of a plant collected by the writer on the slope of the Cerro de Perote, near Parras Coahuila. It is either *A. fissuratus*, or a new species very closely related to it. My guide called it "chautle;" but as I now picture it, lying like a gray stone on the hillside of Perote, I call it "living rock."

^a See Thompson, C. H. Missouri Bot. Garden Rep., vol. 9, p. 128. 1898.

^b Coulter, J. M. Contr. from U. S. Nat. Herb., vol. 3, p. 128. 1894.



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